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JOURNAL
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PART I, 1933.

FIRST MEETING OF SESSION 1932-33, 15th November, 1932

PROFESSOR MAJOR GREENWOOD said that since the last Meeting the Society had lost one of its most distinguished Fellows, who had been present at and taken part in the discussion at the last meeting of the Society: he referred to Sir Bernard Mallet. The Council had passed a resolution expressing the deep sense of loss the Society felt at his death, and a copy of this resolution had been forwarded to the relatives.

LORD MESTON said he felt sure that it was in accordance with the wish of all Fellows that this resolution should have been sent.

STATISTICS IN INDIA.

The INAUGURAL ADDRESS of the PRESIDENT, the RT. HON. LORD MESTON OF AGRA AND DUNOTTAR, K.C.S.I., LL.D. DELIVERED TO THE ROYAL STATISTICAL SOCIETY, NOVEMBER 15TH, 1932.

WHEN an ignorant amateur is introduced into a learned and highly specialized Society, the only contribution which he can safely bring is something that has hitherto been outside their purview, in the hope that, under the screen of novelty, his ignorance may for the moment escape detection. In the case of your Society, that ignoble door of escape is closed; for the range of your interests is so wide and so profound that it would be vain to search even Africa for *aliquid novi*. Hence, when your retiring President brought me your courteous invitation to be his successor, and explained that a presidential address to the Society would be among my duties, I could only stammer feebly that I knew nothing about statistics. To this Sir Josiah soothingly replied: "Perhaps not; but there must be something which you know something about; why not try India?"

The suggestion lay dormant for some time; because India and statistics hardly form a natural association of ideas, a less statistically-minded country than India being hard to imagine. Then came a cheering message from Mr. Macrosty. Your Society, he assured me, had a warm corner in its heart for India. Apart from other better-known men from the East who had served it in the interval, it had had, as one of its founders, that redoubtable Indian soldier and administrator, Colonel Sykes, one of the very last Chairmen of the old East India Company, who actually occupied your presidential chair in the year in which I was born. This touched a chord in my memory; for my father was an enthusiastic supporter of Colonel Sykes, when the latter sat in the House of Commons as Member for the City of Aberdeen; and he used to tell me, as a small boy, tales of Sykes' prowess on the hustings, where apparently he trounced political opponents as lustily as he handled statistical backsliders in this Society.

Here then, though in a somewhat roundabout way, was encouragement to venture to talk to you this evening about India, some of its reactions to statistics in the past and some of its recent developments in the organizing of statistical material. The common people of India are, it may be repeated, anything but statisticians by nature. About such a vital matter as the rent he pays for his land, the ordinary villager is often as vague as he is on the subject of his age. Ask a young peasant how old he is, and he will, as likely as not, reply "Twenty or thirty"; ask his mother her age, and the old lady will hazard "Forty or fifty"; while the grandfather will invert the order and probably tell you that he is "a hundred or eighty." If you are riding down the countryside and try to get a passing rustic to tell you how far you are from your next camp, he will give you "Eight or ten miles," and the chances are that you will find it fifteen. In the matter of time, the popular conception of accuracy is sufficiently served by saying, for example, that a thing happened "in the third watch," that is, at any hour in the afternoon or early evening. A witness in court will tell you, with much show of exactitude, that he caught a burglar "when three *gharis* of the night had gone"; but nobody knows exactly what a *ghari* is, and the best available definition is that it represents the time which a man of temperate habits and in good health takes over 360 respirations. This vagueness about the ordinary measures of life is inherent in the Hindu method of handling phenomena.

It is this Hindu method that forms what one may call the first stage of statistical development, or perhaps more correctly the pre-development stage. It is characterized by an intense interest in figures as emblems, coupled with much indifference as to the relations

between the figures and facts. Figures were used constantly as expressions of emphasis, or as substitutes for abstractions; often in the latter case deliberately, in order to reach the intelligence and strike the imagination of the common people. You remember Macaulay's gibe at Indian history, "abounding with kings 30 feet high and reigns 30,000 years long." It has given offence to Indian patriots, but it is far from an exaggeration. Let us dip into one of the Sanskrit classics, taking at random the Matsya Purana. It has a chapter on geography, where the seven zones of the world are described in considerable statistical detail. Take one of the seven, Jambudvīpa, the region which includes the sub-continent of India, and was presumably best known to the old annalist. Its dimensions are given in *yojanas*; and a *yojana*, according to Benfey's Sanskrit dictionary, is a lineal measure of five or nine miles, a typical example of the liberty of choice in such matters. If we adopt the more modest length of five miles, then the diameter of Jambudvīpa is given as 500,000 miles, while its chief mountain, Meru, measures 120,000 miles in girth. Its great river, Gandaki, is 160,000 miles in length, and after this it is not surprising to learn that "the ladies of that place are beautiful as the lotus," and that the inhabitants of the region live up to 10,000 years.

Here you have a delightful example of the fascination of pure globular figures in the Hindu mind. Sometimes their sheer amplitude seems to be the attraction; at other times there is a sudden zeal for imaginary exactitude. The life of Brahma, for example, is described as being 107 years and 8 months; but as each of Brahma's days is equal to ten thousand solar years in length, his allotted span is about 387 millions of our years. On this point, however, the classic authorities are at variance; for one school of cosmographers argue that one day of Brahma is equal to 4320×100^3 of our years. The divergence seems to have caused no discomfort, or even controversy, in the ancient Hindu world. They had many other statistical problems to divert their thoughts. In the same Purana from which I have been quoting, there is a chapter on the reward of penances performed at Prayag, the modern Allahabad. At that city, where the sacred streams of the Ganges and Jumna unite, rewards are available to the faithful in accordance with a regular schedule. The pilgrim who allows himself to be swung head downwards over a fire (and you still can see them doing it) goes after death for one hundred thousand years to Heaven. He who adopts the milder course of sitting under the blazing noonday sun with four other fires burning round him, goes to Heaven for as many years as there are hairs on his body. He who merely bathes during a lunar eclipse goes to the Moon for sixty thousand years, and is then reborn a rich

man. We drop into bathos when the pilgrim chooses a less auspicious day for dipping in the sacred streams, but even then he earns the reward of being exempt for ever after from having to pay his debts.

A curious sidelight is thrown on the traditional Hindu respect for pure figures by the fact that, in Sanskrit and at least some of the modern vernaculars derived from it, there is a separate word for each number from unity to 100. They do not speak, for example, of ninety-one, or of four score and eleven, but give the figure a distinctive name of its own. Similarly, when we get beyond 1,000 in the powers of ten, we in English have only three terms in ordinary use—the million, the billion and the trillion—and it is only the first of these that means the same thing in all the countries which use it. Sanskrit, however, has a clear and separate word, sometimes enriched by an alternative, for each power of ten up to the twenty-first.

You must forgive this *pot-pourri* of instances of the triumph of numbers over statistics. They are cited merely as indicative of the absence of any statistical sense, just as there was a striking absence of all historical sense, in the ancient Hindu philosophy. In some ways it was a rational sequel to the Hindu theories of life and eternity; at the same time, it was a curious concomitant of the marvellous skill of Hindu mathematicians in calculating, with the primitive material at their command, such phenomena as the revolution of the earth on its axis, the occurrence of eclipses, and other advanced astronomical formulæ.

The second stage of India's statistical development comes with the advent of Mohammedan rule. The Moslems were as interested in history as the Hindus were negligent of it, and as appreciative (according to their lights) of exact statistics as the Hindus were indifferent to them. Much of this you can of course trace back, through the Arab doctors, to Greek influences. With their essentially practical minds, the Moslems transferred the field of Indian research from eternity to time, and from the heavens (which the Hindu astronomers had searched with remarkable results) to the earth. It was literally the earth which led to India's real statistical awakening. For both the military power which secured the Moslem invaders in their occupation of the country, and the splendours of the Imperial Court at Delhi, were based upon the taxation of agriculture. Thus it was that the tenures of the land, its output and its taxable capacity, became the material for an elaborate statistical system of which we still reap the benefit.

The classic for this stage of development is the *Ain-i-Akbari*, or Institutes of the Emperor Akbar. Compiled in Persian by his vazir, Abul Fazl, towards the end of the sixteenth century, it is an extraordinary jumble of information, which Moreland is no doubt right in

describing as “a collection of official papers contributed by the various administrative departments, edited by Abul Fazl, and containing occasional matter from his pen.” It begins, for example, with a disquisition on the specific gravity of metals, the methods of refining and coining them, which could have been put together only by an expert from one of the many Mogul Mints. There follows a long list of recipes for the Emperor’s favourite dishes, obviously contributed by a *cordon bleu* in the Palace kitchen. After this, however, we have an invaluable schedule of current prices, a mine of information for those who study the fluctuation in values during the last three and a half centuries. Some of its readers must have found the schedule almost embarrassingly rich. It embraces 44 varieties of food grains, 18 sorts of vegetables, 19 kinds of meat and game, 15 spices beside salt, 34 types of pickles, over 100 fruits and pot herbs, 33 perfumes, 122 manufactured cloths, 77 different weapons and pieces of armour, and a great variety of building material. Does this fire any of us with the ambition to prepare an index-number for Akbar’s reign?

The real interest of the *Ain*, apart from its archæological value, lies in Part III, entitled Regulations for the Revenue Department, and in the later chapter, where the revenue assessment of the whole empire is catalogued. Although new forms of revenue are now prominent in the budget of British India, the land still remains one of the chief sources of the State’s income. The methods of assessing that income constitute a long and honourable chapter in the history of British rule; and Akbar’s experience in devising just methods of assessment can never lose its interest for the British administrator. Old Abul Fazl takes us into his workshop and shows us how he did it. He certainly began at the beginning; for His Majesty first, says the historian, set to work to determine an era. Our Christian era is now so exclusively established over a great part of the modern world that we are apt to forget how real a difficulty was the multiplicity of eras in the older world. Akbar solved that difficulty by inventing one of his own, with a strictly solar year, which, parenthetically, was afterwards rejected by the stricter Moslems as being heretical. Having got his time basis, Akbar came to the area basis; he invented also a yard measure of his own, equal to 41 fingers, and a square measure to correspond, consisting of 3,600 such square yards. His next step was to have an estimate made of the average yield, per unit of area, of each standard crop; and one-third of this was declared to be the share of the crop which theoretically belonged to the State.

What followed is set out in the series of elaborate tables which are printed at the end of the first volume of Gladwin’s translation. They profess to record the rates of revenue (or land tax) imposed on

each crop, in each province of the Empire, from the sixth to the twenty-fourth year of Akbar's reign or era. The interpretation of these tables, obscure and much disputed, has recently been settled by Moreland's brilliant analysis in his *Agrarian System of Moslem India*, and it is of consuming interest to see how Akbar and his experts groped their way from the mediæval to the modern system, all within one generation. The mediæval method was simply for the Crown to take one-sixth of the gross produce. How this was collected and stored and disposed of, and how the cash proceeds were remitted to the Treasury, would be a tale of oppression and incompetence and roguery such as never has been told¹ and never will be told. The manner in which Akbar began his reforms in the sixth year of his reign was to assume a standard output for the different staple products, and to value it at fixed cash rates varying with each crop, but otherwise uniform for the Empire as a whole. With an enormous Empire, tardy means of communication, and an immense difficulty in getting through the barriers of red tape at the centre, it took a long time for mistakes to be admitted and rectified. In this case, it was only a few years before experts showed that the system was far too rigid; and gradually the uniform schedule of valuations for the staple crops was replaced by local schedules applicable to different parts of each province. The fatal flaw, however, remained that the output of each crop-unit of area was assumed to be constant throughout the vastly different tracts of country, with every possible grade of fertility, in the Empire.

Towards remedying this defect, and in the period from the fifteenth to the twenty-fourth year of Akbar's reign, the rigidity of the assumed output was relaxed, and the crop-dues of the State were fixed separately by local areas (known as *parganas*) which were more or less homogeneous subdivisions of each province. It was just as if the actual yield of wheat per acre, to take an example, had become a standard figure fixed by counties instead of for England and Wales as a whole. The assessments were then, as Moreland puts it, based on local schedules, containing two variables in each case—a crop-due and a price—instead of fixed crop-dues commuted at varying prices. This in time broke down because of the evil of centralization which lurked in it. The price schedules, it would appear, required the sanction of the central government before they could be applied, and if the Emperor happened to be engaged in some far-distant campaign or progress, the sanction might be delayed until the utmost confusion arose between the collectors and the unhappy taxpayers, the peasantry. For this, the Emperor himself discovered the corrective. The periodical price schedules were abolished, and the assessment on each crop was made in cash, on the basis probably of some average

of actual cash payments in the past; and when made, it was stereotyped for ten years. Certainty was thus introduced into the system, and its effect was, to quote Moreland again, "to transfer from the State to the peasantry the benefit and the burden of fluctuations in prices resulting from seasonable variations or other causes."

From this solution our present system of assessing the land revenue of India derives in almost apostolic succession. What is even more important is that it was the seed of our present system of land records, one of the most elaborate and valuable statistical schemes in the world, and a source of legitimate pride to all who had ever been associated with it. To this aspect of the matter I shall revert in a moment. Meanwhile a very brief diversion is permissible to the second great table of statistics in the *Ain*. This is no less than a catalogue of the fifteen Viceroyalties into which the great Emperors' domains were divided, including portions of states such as Kashmir, Baluchistan and Afghanistan, which no longer belong to the Indian Empire. Each of these provinces was constituted of a number of *Sircars* or counties; these again being subdivided into townships or parishes. In Abul Fazl's great compilation, the area of each *Sircar* is recorded; and for the great majority of the townships there is a figure in money, which is now believed to be the administrative valuation of its land, or its theoretically taxable capacity. Finally, there is shown for each *Sircar* the number of cavalry, of infantry, and of military elephants which it could be called upon to contribute to the imperial forces. Unfortunately, the civil divisions of the country to-day do not correspond, except sometimes in name, with those of Akbar's day; but the figures are rich in information, for those who know how to extract it, as to the degree of control by the central government over the different parts of the Empire. Where the valuation is given in detail, down to shillings and pence, so to speak, and the figures of the measured area are equally precise, one may assume the official machinery to have been perfected and the imperial power recognized. Where, on the contrary, the valuation is in round or speculative figures, or the measurements are blank, the probabilities are that authority had not yet been consolidated; and where no valuation at all is shown, the territory may still have been in the hands of local chiefs, in ambiguous relations with the central power. When we get to the more martial outskirts of the Empire, money tends to disappear; the land surveyors from Delhi probably were a little chary of peaceful chainwork in those wild regions, and the taxable capacity is sometimes reported in terms of camels, sheep, barley and butter.

This, however, is getting away from statistics, and it is time to return to the wonderful system of land records which the Grand

Mogul bequeathed to his successor, the British Crown. It has been elaborated and modified and changed in infinite detail during the intervening centuries; but without the groundwork established by the Mogul genius for administration and the traditions which it indelibly impressed upon the minds of the Indian peasantry, it is doubtful whether we, with our own sloppy methods of land registration, could ever have designed a scheme of anything like comparable value. Before dwelling on its statistical wealth, a word of general explanation is necessary. In giving it, I shall speak, not of India as a whole (because any generalization about India is dangerous), but about the particular province which I know best, a province which was very much in the eye and under the control of the Mogul Court. At the basis of the whole system stands the village, or, as on a rough analogy I have earlier styled it, the parish—the tract of land surrounding, and in the main tilled by the community residing in, the hamlet. It may be 500 acres in area, or it may be 1,000; and it is carved up into at least twice as many fields as there are acres. The village has a large-scale map, upon which each field bears a distinctive number. The village, or little group of adjoining villages, has its accountant; he keeps and corrects the map and all the annual registers; and it is on the shoulders of this overworked, underpaid little man that the whole land-records structure is built up. It embraces the following. First, there is a register in which the names of the owners of the village lands are entered; there may be only one, or there may be a family holding jointly, or there may be a multitude of small people with fractional shares; but in every case the register shows the exact proprietary interests, and the land tax or revenue for which each owner is responsible. Second, there is a register which shows, in serial order for each field in the village, the name of the owner, the name of the tenant if it is let (or of the sub-tenant), the area of the field, the crop grown upon it, what rent (if any) is charged, where and by what means it gets irrigation. Third, there is a register in which all payments of rent are (or should be) entered as they are made. Besides these, the poor little village accountant has to keep up a number of other books which bear less relation to our story.

From this very rough and imperfect summary it will be seen that in each village tract we have a complete annual record of proprietary and tenant rights in the land, of crops and crop areas and of rents. There also exists an efficient machinery for collating and tabulating all this information for the province as a whole and—so far as it is possible—for the vast expanse of British India. In comparatively recent times there has been added to all this a systematic practice of harvest measurements (chiefly by actual weighing on the threshing-

floor or whatever corresponds), whereby an estimate of very reasonable closeness is made for the yield of all the staple products of the soil. You thus have a gigantic and constantly tested volume of statistics such as is without parallel on any similar scale in the rest of the world. They play an essential and invaluable part in the ordering of village life, as well as in the collection of the Government's revenue; but it is their statistical aspect alone which concerns us to-day.

Constantly tested those records are; for a staff of supervisors move steadily about the villages, keeping the accountants up to their work. One of the prime duties of the young English civil servant, when he first goes out to India, is the checking of these records on the spot. In them he early learns the beauty of careful statistics; even if, as in my young days, they afforded almost the only example of any statistical exactitude. At a later stage he realizes their immense value, especially if he joins the ranks of the picked men on whom rests the responsibility for "settling," as it is called, the incidence of the taxation on the land. As in Akbar's time, so to-day, the well-being of the vast rural population of India depends on two things—the regular action of the monsoon winds, and the wise assessment of the Government's land revenue. Statistics, alas, do not influence the former; but they are of vital importance to the latter. The assessment of land revenue is revised at intervals of thirty years or thereabout; and our working rule (I am speaking again of only one typical province which I know well) was that the State took one half of the rents which the landlord collects from the cultivators, or which a good landlord would collect if he managed his estate prudently. Parenthetically, lest this should seem to some of you a heavy burden, let me remind you that all the land in British India is Crown property and that the so-called landlords are only intermediaries; also that in Mogul times the ratio of the tax was roughly 90 per cent., which we have gradually reduced to a theoretical 50 per cent. and to what is in practice a still lower figure. Now, in order to give effect to his theory, the settlement officer has primarily to determine what may be described as the fair competitive rents over the land he is settling. If the landlord has failed, through negligence or otherwise, to secure a fair rental, the State must not suffer. If he rackrents his tenants, the fair rental calculation enables the special courts to relieve them. If he has attempted to defraud the State by concealing his rents, the fair rental acts as a detective. Thus it is of first importance to work out fair competitive or, as they are often called, standard rates of rent for each class of soil—loam, sand, black cotton soil, etc.—in homogeneous tracts throughout the district which is being assessed. The statistics initiated by the Grand Mogul rendered this remarkably

easy. You took up the village map, marked off, as you wandered round the fields, a number of representative plots in the different soil-blocks, and then put a reasonably careful clerk to work to extract from the village accountant's record the area and rent of each field which you had marked in the course of your morning's round. By evening you were given a list of rental rates per acre for each class of soil. Running through the list with a pencil, and eliminating rates which were obviously abnormal from any cause, innocent or otherwise, you quickly pitched on a norm. Checking this next day in the same manner for another village or group of villages, you soon discovered standard rent rates for the whole tract, and the basis of an equitable assessment was surely laid. The whole business was a striking example of how the existence of good statistics facilitates the task of good government.

A moment ago, I hinted that all our statistics in India were not, at one time, worthy of particular commendation. Besides the land-records, we had others to work with; and some of them, either in their preparation or in the use made of them, would hardly be edifying to this learned Society. There were certain official statistics, for example, of crime and convictions, by which in those unregenerate days the energy and efficiency of the police were judged. I remember hearing, as a very junior magistrate, a case in which the accused was charged with murdering a neighbour. The evidence was worthless and I refused to commit the prisoner. The superintendent of the district police came to see me sorrowfully about it the next morning. He admitted that there was no proof of murder, but plaintively asked if I could not have found the accused guilty of using indecent language. "Possibly," I replied, "but what would have been the use of that?" "Well," said my police friend, "it would have gone to my credit as a case successfully prosecuted to conviction." One other trivial reminiscence. In these same distant years I was touring about an area where female infanticide was rife. I need not stop to explain the reasons for that atrocious custom; but it was discouraged by a searching test of the vital statistics in suspected villages, with serious penalties in the background. The vital statistics in question, however, were provided by old, illiterate Dogberrys with erratic memories; and they were liable to be further vitiated by friendly villages lending each other their infant girls when there was any fear of the inspecting officer considering the local supply to be inadequate. Our method, however, was to go into a village with the list of recent births, assemble the village mothers and their tiny progeny, check the list with the visible infants, and then decide, upon the ratio between surviving boys and girls, whether secret infanticide was still in vogue, and whether police surveillance continued to be necessary.

It was a terrible example of what one may have to do with bad statistics when good statistics are not attainable.

At the time I speak of, between forty and fifty years ago, India was in the statistical doldrums. It had consigned the old Hindu methods to their own literary limbo. It had used, and greatly improved upon, the statistics of agriculture areas, tenures, yield and rental values, which had come down from the Moslem administration. But, save in one respect, it had struck out no new development under British rule. That exception was certainly a remarkable one; it was the decennial Census. The first regular census for British India—regular as being an attempt to enumerate the people by actual counting of heads—was not made until 1871; but each of its successors has gone from strength to strength, and the work, when regard is had to its immensity and to the poverty of the available machinery, has well earned an international reputation as a masterpiece of organization. With its chief characteristics this Society is already acquainted, and I need not weary you by repeating them; especially as you once had for your President the ablest of all our Indian Census-takers in Sir Athelstane Baines. With the exception of the Census, however, and old Akbar's legacy of the land registry, our statistical equipment in India fifty years ago was terribly weak. Even in the great *Imperial Gazetteer*, published twenty-five years ago, the writers complain of the scarcity of straw for their bricks. "Detailed statistics regarding rent," writes one of them, "are not as a rule available for any but small areas, and in Bengal they are almost entirely wanting." The chapter on Wages has similar complaints. Statistical data on the subject are described as "seriously defective," and as giving only a rough indication of the course of wages. They did not, for example, discriminate between rural and urban areas; they gave no information on the method employed in the provincial official tables for converting into cash the important types of wages which are habitually paid in kind. And we watch one very competent authority in the same volume struggling with the problem of index numbers for wholesale prices. In the matter of imports, he had to be content with taking five of the leading articles of import at Calcutta in his day—two classes of cotton yarn, grey cotton shirting, copper braziers and flat iron—and working out what he called an "average or index number" on these five commodities for the previous forty years. No estimate could apparently be made of the relative importance of these five staples, and no weighting was attempted. In the matter of exports, the calculation was no happier. Ten of the commoner articles of export—rice, wheat, jute, tea, etc.—were priced; the prices were added together, the total divided by ten, and the result shown as an "average or

index number " for the wholesale prices of export commodities. It must not of course be concluded that these pseudo-index numbers were employed for any scientific treatment; they are cited mainly as showing how haphazard and unsatisfactory was our recorded information at the time.

Towards the end of last century, the third or British stage of development began to dawn. Among its earliest manifestations was the publication, for the first time, in 1884, of a volume called *Prices and Wages in India*. The value of the figures for wages we have already seen. The price figures were based on certain fortnightly returns which the *Gazette* of India had been collecting from most districts for the staple food-grains and salt since 1873. They were supplemented in 1886 by a detailed catalogue of prices amassed in Bombay by a certain Meteorological Reporter who was an enthusiast on the connection between price variations and sun-spots. They are very erratic, and have to be taken with great reserve in any scientific study of the cost of living. But they do indicate certain general tendencies, not without interest; for example, the startling variations which the absence of communications permitted in the price levels of adjoining districts in those early days; the marked fall of prices in the first half of the nineteenth century and the equally marked rise about 1860, when the movements of the new era of commercial and industrial activity, inaugurated by the transfer of India to the Crown, blended with the effects of the American Civil War and the powerful stimulus which it gave to the production of cotton in India.

General deductions of this sort it was possible to draw from the old compilations, but the necessity for more precise analysis became increasingly urgent; and the impetus of a real advance came, as usual, from the busy and far-seeing brain of that great Viceroy, Lord Curzon. It was he who succeeded in securing the establishment in 1905 of a new department of the Central Government, whose function was to attend to the needs of the commerce and industry of the country; and one of the leading officials of the new department was a Director-General of Commercial Intelligence, specially chosen to be an intermediary between the Government and the mercantile public, and to control the preparation of statistics. So absorbing became the second section of his duties that, when the Central Government moved from Calcutta to Delhi, it was decided to separate the statistical work into a sub-department of its own, and a whole-time Director of Statistics was appointed in 1915. In sanctioning the appointment, Lord Crewe, the then Secretary of State, formally recorded his conviction that " the compilation and publication of statistics holds a foremost place among the duties of the present post, and the

supervision of this work requires the undivided attention of an experienced officer."

Although the post was, in the hard years which followed the War, abolished ostensibly on grounds of economy, the work has not stood still. A quarter of a century ago, the Home department was still thrusting upon an unwilling world its "Judicial and Administrative Statistics," a folio meagre in its tables, uninformative in its matter, repulsive alike in its form and its colour. To-day the story of India is brought to us yearly in the cheerful chubby octavo volume known as the *Statistical Abstract of British India*, crammed with information such as is to be found with difficulty within the same compass in any other country of the world. That is the measure of the advance that has been made; and the student of progressive administration will derive no small satisfaction from comparing the two productions. Not that the little octavo is yet perfect; no statistics ever are. It allots, for example, one niggardly page to the whole output of literature, periodical and otherwise, in India; while it gives a generous six pages to the ætiological factors and previous occupations of lunatics. These, however, are but trifles; on many of the most important phases of national life—railways, industries, life assurance, banking, currency—it brings together, in convenient form and suggestive detail, a mass of material which it would cost the investigator much time and labour to collect for any other nation. And of course it is little more than a glorified index to the immense volume of available data from which it is abstracted.

That is my story. It does not bring, as your President ought to bring, any contribution to the accumulated wealth of knowledge of which this Society is the custodian. It does not profess to do more than throw a faint side-light upon some of our activities. When the skilled artisan is busy on some minute, though vital, component of a great engine in his workshop, his mind is of necessity engaged on perfecting it, and his fancy does not stray to the completed structure. Still less does he allow himself to dwell on the future of the monster upon which he is toiling,—on the distant lands which it will traverse, the wide horizons which it will bring within the reach of men. So with much of the work accomplished in this Society. The individual expert may be engrossed in some abstruse mathematical problem; his colleagues may be active in helping to polish and perfect the formulæ which emerge from his labours. You may have little time to think of the ultimate uses they may serve, whether in the world of science, or of trade and commerce, or in the business of the State. But that is their real and final purpose. The public administrator, like the successful business

man, knows this, and values the craftsmanship of statistics accordingly. I have tried to show you how true this is of an Eastern country where the statistical sense is exotic. The need for good statistics was grasped, over three centuries ago, by one of the master minds of the world, the Emperor Akbar; and though his crabbed records are now little more than historical curiosities, they provided an inspiration to the Western race who succeeded to his throne, and who show to-day their steadily increasing appreciation of good statistics as a part of the machinery of wise government.

PROCEEDINGS OF THE MEETING.

SIR JOSIAH STAMP: It is owing entirely to the long custom of the Society that I as his predecessor in office have the honour of proposing the Vote of Thanks to our new President for his address to us. It is a great privilege and also a pleasure, for although I know very little about the subject of the President's address, I know something of the President's life and work, and I should like at the outset to extend to him on behalf of the whole Society a very cordial welcome to his post and thanks for his presence here amongst us.

There is some connection between this Society and India, and therefore we are not entirely upon ground that does not belong to us. Apart altogether from the importance of the statistics of India and Indian Government problems, we have on our roll of Fellows a very large number of Indians and I believe this considerable body of Fellows—who, we have evidence, read our *Journal* and Proceedings with great care—will regard the presence of Lord Meston as President of the Society as something in the nature of representation. His name is known so well amongst them, that to find him in the place of honour of the Society will, I think, give great pleasure to a considerable body of our Fellows who in the past may have thought that they had no representation of their outlook or interests, and that there was no one here who professed to know much about them. I say this without looking back over the long list of those who have held office in the Society, to see whether we have had prominent Anglo-Indians before. I speak more of the present Fellows, who may think that the presence of Lord Meston is a happy augury for things Indian. They too, with the appreciation of scholarship and all that it embodies, will feel honoured that we have as our President one who holds the high office of Chancellor of so ancient a University as Aberdeen. We feel thankful for the presence of Lord Meston, and are proud to have him as our President.

Lord Meston gives us a paper which starts off with an engaging unaffected simplicity to tell us that he knows nothing of the statistics in which we deal, and then he plunges us all out of our depth into a field of knowledge ancient and modern. But he has protested too much, and even in the concluding paragraph there is an overdose of

what we usually regard as presidential modesty as to his fitness for the presidential position.

His vast experience in government will be of great service to us; we have evidence here that his mind is alive to some of the fundamental issues involved. I should say that the underlying philosophy of his address is that very important one of bringing us back to the human basis of statistics, not only their finer uses, but also in many cases in their actual origin. He gave us a most enchanting story of the early history of statistical ideas in India some centuries ago. Do not let us be too supercilious. Look back at the origin of our own science, and we find medicine still in the lap of magic, astronomy with astrology, and chemistry in connection with a mixture of mumbo-jumbo and alchemy. We have nothing ourselves to boast about when going back several hundred years. There were interesting theories, but they chiefly show that we should not attempt to draw any very exact statistical information from the Book of Revelations or of Daniel, as certain theologians have done in the past.

We come now to a period when we can no longer afford to be impressionistic over statistics, and with the modern methods of Government machinery. Those of us who met Gandhi when he visited this country recently, and heard him talk and answer in debate, cannot fail to have been impressed by the fact that he had got to the first stage of statistics—the stage of using tendentious statistics in public affairs. It is the intention of Lord Meston to take statistics a step further, beyond that stage, to the less “attractive” field of more exact methods. One could not help being impressed by Gandhi’s statistics of standard of living, wages and population, and by his open disregard of all qualification, or of anything that trammelled his argument. He reminded us of a statesman of our own, who when caught up on his statistics, brushed it on one side, saying, “Statistics are only used as illustrations.”

Do not let us be too superior in regard to the popular statistical ideas in India to which Lord Meston has referred—to the gentleman who tells us he is aged between thirty and forty and the lady who says she is between twenty and thirty. Would you rather have someone who did not know at all, and yet who told you with a great air of assurance that he was forty-five, which figure was duly entered and recorded, and eventually perhaps an Act of Parliament passed on the basis of that and other such figures, or the lady who knew she was twenty-eight and glibly says she is twenty-three? Is it not better to have someone with a statistical sense who gives you an upper and lower limit of probability? The modern device for getting out of difficulties by giving a plus or minus sign is much the same thing. Why blame the Indian mind? Is he not the better statistician? This agony of mental exactness is quite a common feature in all minds that are not used to precise thinking. I think it very often arises from a certain amount of suspicious caution. It reminds me of the ferryman who was asked what was the average number of people he took across the river in the day, and who replied that there was no average; sometimes he took a

lot, sometimes only a few. No amount of coaxing could get him to give a more precise statement than that. There are plenty of people who, when asked what two and two make, hesitate to say four, until they are certain what you are going to do with the result. Anyone acquainted with the field of statistical investigation will tell you of that background of hesitancy. Sometimes there is the merely Irish desire to please; anyone who has been walking in Ireland will understand what I mean. You ask the distance to the next town and are told it is five miles, when in reality you find it is ten.

The Indian statistics Lord Meston has been giving us would be a paradise for many of our politicians. There are many interesting threads in his address for which we can find analogies in our own experience; much that he has told us about taxable capacity would be comparable with the history of land assessment in Ireland, and much that he has told us of the building up of a standard land value is similar to the schemes in the early Property Tax; provision was made in the Act much along the lines Lord Meston has given for building up a total or proper value from samples. In many fields of early statistics, parallels could be found for the difficulties he has shown us in India.

There are some respects in which we cannot afford to be too self-satisfied. He has given us particulars of that wonderful land record, and included in the number of things it has summed up is the *use* of land. In this country we are only just now embarking upon that large undertaking—the Land Utilization Survey for the Year 1931, supervised by the London School of Economics—so that India thought of something years ago that we ourselves have not really yet completed. India also appears to have much more knowledge about the previous history of lunatics than we have in this country, and there they can claim to score over us.

What appeals to me most is the underlying lesson—the human basis. If any of you have ever entered into argument with Harold Cox and advanced any exact statistics to convince him, you will know how he will brush them on one side and say, “When I was a young official in India I remember going to my superior officer with a very elaborate problem based upon statistics, and when I had explained it to him he said to me, ‘Young man, when you are as old as I am you will not rest so heavily on statistics. The Government can collect statistics, add and subtract, advance them to the *n*th power, derive formulæ and pass Acts of Parliament upon those statistics, and all the while the figures upon which they have been based have been made up by the chowtydar (village watchman), who just puts down what he damn well pleases.’” Whether or not the village watchman is still the basis of all the great structure of Indian statistics I do not know, but it brings us down to the questions that everyone of us ought to ask when engaged upon new statistical work, or the interpretation of it: “Where does it come from?” “Who draws it up?” “What kind of a man is he and what qualifications does he possess?”

Whether the matter be the filling in of income tax returns, or

vital statistics, or a census, it is always a salutary exercise for a statistician to go first through an interrogation himself upon the origin of the figures. We always take refuge in the feeling that these human errors will cancel out, but how far that is true in every field I should hesitate to say.

In conclusion, in proposing the vote of thanks I would like to repeat what I said when I started, that we extend a very hearty welcome to Lord Meston, and we congratulate him upon giving us a most original and entertaining paper.

PROFESSOR JEVONS: I have much pleasure in seconding the Vote of Thanks to Lord Meston for his address. He had a special qualification for addressing us on the Statistics of India. During his long and distinguished service as an Indian Civil servant, in the early years, he had personally to supervise the collection of the statistics of land revenue and crops which he has described to us. Later in his career, as a high officer of Government, and as Governor of the United Provinces, he was in the position of having to make use of the available statistics for the purposes of administration, and administration in a particularly difficult time at the beginning of the Great War.

I am just a little doubtful about the idea that India is not statistically minded: at least one would like to feel that it was realized that other countries in the world also are not statistically minded. Sir Josiah Stamp has hinted that probably we were not so minded a considerable time ago; and this has led me to try to think out why a nation does become statistically minded. I suppose it is the development of political ideas and of national consciousness which makes people want statistics about themselves. We began to go in that direction in the seventeenth century; India only during the last forty or fifty years. Until there is a real demand on the part of the public for the statistics it wants to use, probably the Government does not supply them, or supplies only those it finds necessary for its own purposes.

Going back to the origin of some of the public statistics of India, as Lord Meston has hinted, will show us the need of considerable caution in their use. He has referred to the wages statistics; these used to be collected by a clerk in the office of the collector, more or less as a matter of spare time occupation. The clerk was sent round to make enquiries here and there, and if his superior officer did not take an interest in these figures, he did not find time for the work, and the figure sent in was the same as that for the last year, until it became notorious that a change had taken place, as during the war. Where the Government is really interested in the statistics, great trouble is taken to provide accurate figures.

I do not think we can assume that in Indian statistics errors tend to cancel out. I have noticed a peculiar bias, in that they often want completeness and tend to be below the true figure, because they are obtained by counting, and no estimate is made for an allowance for errors of omission. I took part in the census of India at Allahabad in 1921, and was very much interested to see the

kind of mistakes that could be made. It seemed to me that an error of something like 2 per cent. under the true figure of population was quite possible by the methods which were being followed. As regards crop reporting, in everything except the area of the crops it may be taken that the true figures are higher than the published figures. The worst case of all is in regard to vital statistics, where, of course, the births registered are very much below the true figures. The figures of last century are utterly unreliable, because there was no real compulsion to report births. Nowadays in towns proper arrangements have been made for the reporting of births, and they are actually checked by the municipal sweepers. It is very necessary to have some check, as people neglect to register births. The municipal sweeper on his rounds questions the servants of various people, hears a baby has been born, and sends his report in to the Municipal Department concerned. With immense trouble, the birth-rates have become fairly accurate in the towns; but this cannot be said of the country districts—in fact in parts of Burma a few years ago it seemed that probably hardly 50 per cent. of the births were being registered, so that any work on the statistics was useless.

Of course the same can be said of nearly all statistics which have not some precise or essential background, and very considerable errors may creep in; on the other hand, in recent years the Government of India has been making great efforts to obtain more reliable statistics in various directions. The question of wages has been constantly before them; and we have the prominent example of the Labour Office that has been started in Bombay. Mr. Findlay Shirras started the Labour Department in Bombay with a special staff for the development of statistical work. Mr. Burnett-Hurst had done work in that direction before in Bombay and had shown the great advantage of enquiry into family budgets. This was taken up on a large scale in Bombay, and some valuable reports have been published on family budgets, earnings of cotton mill employees, agricultural statistics and index-numbers of wholesale prices and cost of living. Subsequently similar work was instituted in Rangoon by a special Labour Department established by the Government of Burma to investigate the cost of living and wages amongst the Indian immigrants, whose social condition is extremely bad; and a valuable report in accordance with modern statistical methods was issued as a result of that enquiry. These are two examples of various directions in which improvements are being made.

The President did not say very much about the uses of statistics and the various purposes to which they are being applied at the present time, though he mentioned the tendentious character of the use made of them by politicians. I think we may say that the danger of statistics in India being used more and more for political purposes is one that ought to be kept clearly in view. I have noticed one or two peculiar instances of this. Take, for instance, the extraordinarily high rate of infantile mortality in Bombay of 600 per 1,000. That has been quoted by a number of Indians as

an example of the terrible conditions created in Bombay by British rule. Some such statement was published in the *New Leader* in this country. We know that conditions are very bad in Bombay and that Government efforts to improve housing conditions have not been altogether successful; but although the true infant mortality rate is much higher than it ought to be, that is not the reason for the very high official figure. The real reason is that the women who work in the cotton mills in Bombay come from distant places in the country. When they are pregnant and about to be confined, they go to the villages, and if the birth is registered at all, it belongs to those country districts. They bring the children back to Bombay, and frequently within one year those children die, and the deaths are registered in Bombay.

I found in Rangoon an even more striking case. I was very much puzzled in studying the infantile mortality rates of the Municipal Council to find that the highest rate, of something like 900 in 1,000, occurred in the Civil station, the best part of the town, where the European residents live, together with a few wealthy Burmese and Chinese. What could be the reason for that? At last the reason dawned on me. The European women went to the maternity hospitals in another Ward; and there had been an increasing tendency for the wives of the Burmese and Indian servants who also lived in this Ward, to go to maternity centres, of which there was none in the Civil station; so that the births were all being registered in other Wards, but the deaths in this particular Ward. That is some slight indication of the difficulty of dealing with statistics in that country.

I feel grateful to the President for his very pleasant phrase, "the craftsmanship of statistics." That expresses it very well indeed. There is a definite craftsmanship in the drawing of inferences from numbers; and it is something which this Society does foster in this country, and perhaps could do more to foster in India and other parts of the British Empire—the science of statistics. I should like to thank Lord Meston again, and second this Vote of Thanks.

SIR JOSIAH STAMP: Lord Meston was told before he accepted office that Presidential addresses were neither discussed nor criticized; they are appreciated, absorbed, and even lauded; therefore we are not to have any further range of speeches, which I am sure would easily be forthcoming on such a topic. It is my pleasure to put to you the Vote of Thanks which I myself proposed and which Professor Jevons has seconded.

The Vote of Thanks to the President for his address was put to the Meeting and carried unanimously.

LORD MESTON, in reply, said: This is a somewhat unusual procedure. I understand that the ordinary meetings of the Society are signalized by the fact that immediately after a Fellow has read his paper, he is pounced upon by a great number of experts who proceed to tear to pieces his figures, formulæ, and argument.

I feel therefore I must take with considerable reservation the extraordinarily pleasant things that have been said by Sir Josiah Stamp and also by my old colleague, Professor Jevons. As I said at the beginning of my paper, I am not able to bring to this Society contributions in kind, but I may, I hope, be able to be of some use to it during my two years of office, and I shall spare no pains to render it any service I can.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society :—

Sydney Edward Joseph Brady.
François Daubenton, M.D.
Richard Leslie Grennan.
Thomas William Griffiths.
Horace Frank Hill.
Alfred Tozer McKay.

Sigmund Metz.
John William Morcher.
Henry William Povey.
George Arthur Grantham Stanley.
E. C. Tommerup.

Corporate Representative :

Nancy Powell, *representing* the J. Walter Thompson Company.

A SURVEY OF THE USES OF
STATISTICAL METHOD IN THE CONTROL AND STANDARDIZATION
OF THE QUALITY OF MANUFACTURED PRODUCTS.

By E. S. PEARSON, D.Sc.

[Read before the Royal Statistical Society, December 20th, 1932, the President, the RT. HON. LORD MESTON, K.C.S.I., LL.D., in the Chair.]

(1) INTRODUCTORY

THE function of statistical method in industry has been most commonly associated with problems of marketing, using that term in a very wide sense. Less attention has been given to the part it may play in the improvement of the production process and in increasing efficiency in the fitting of supply to satisfy the wants of the consumer. Recently, however, there has been a growing realization of the benefit which industry may gain by the application of this branch of scientific analysis to the solution of a whole range of problems in production and standardization. The movement, closely associated with the Research Laboratories of the Bell Telephone Company in New York, has probably made further headway in America than in Europe. For a number of years, isolated firms in England have realized the value of statistical tools of this nature, but it was undoubtedly the interest aroused by the visit to London in May last of Dr. W. A. Shewhart of the Bell System that provided the encouragement towards concerted action that was needed.*

Since then one aspect of the problem has been taken up by the British Standards Institution, and the survey contained in the present paper owes much to the results which have followed from the contact between the statistical and industrial members of the committee appointed by that body. Such co-operation and understanding between the theoretical and practical worker are essential, for the field to be surveyed is to a large extent unexplored and the tools required for its development are not, in many cases, at hand ready made.

(2) VARIATION AND HOMOGENEITY

The first point that I would like to emphasize is that, although the producer, whether he deal in raw materials or finished articles,

* I would like to take this opportunity of acknowledging warmly what I owe to Walter Shewhart and his book, *Economic Control of Quality of Manufactured Product*, with its philosophy of approach and wealth of illustration.

may aim at supplying the same thing again and again, he does not in fact achieve this result, nor, indeed, is ever likely to do so. Quality will vary from one unit to another much in the manner illustrated in the following examples, for which the variation is shown diagrammatically in Fig. 1 :

(a) The tensile strength of 120 small briquettes of a particular brand of cement-mortar, tested at the Building Research Station.

(b) The length of life at marked voltage of 150 electric lamps, removed for routine testing during the normal course of production.

(c) The percentage ash-content in coal obtained from the chemical analysis of 250 samples of a certain rough slack. The testing formed part of the routine practice of a large firm of consumers, and the results given cover a period of about 5 years.

These are not illustrations of badly controlled products, but the figures are typical of results that will be found whenever measurements of quality are taken. The criticism which may be levelled against the producer is not necessarily that variation in his product is excessive, but that he has so little exact knowledge of the nature and extent of this variation, and therefore cannot appreciate fully the results that follow from it. A standard of quality cannot, in fact, be represented by any single measure, but rather by what may be termed a distribution-function. A frank recognition of this fact by producer, consumer, and standardization authorities is a first step in the direction of a more economic control of production.

When dealing with a single quality characteristic, for certain purposes this distribution-function can be adequately defined by the mean and standard deviation, and I have shown in the diagram the way in which the three frequency distributions are scaled off by adding and subtracting multiples of the standard deviation (σ) to and from the mean. These two measures will not, however, always be sufficient, particularly if the variation is asymmetrical.*

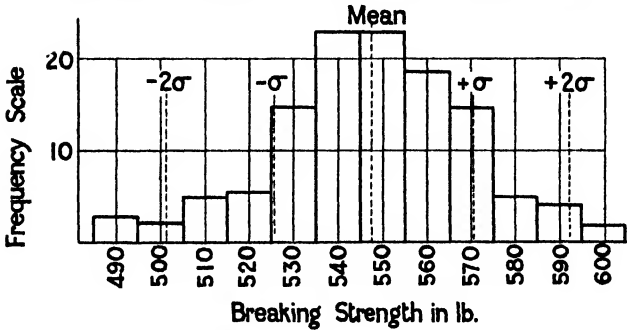
The next point that I wish to stress is this. There must be variation, but much important information may be lost by allowing it to pass un-analysed. A single example must suffice at this stage to illustrate my point.

Among the Standard Specifications for Malleable Castings issued

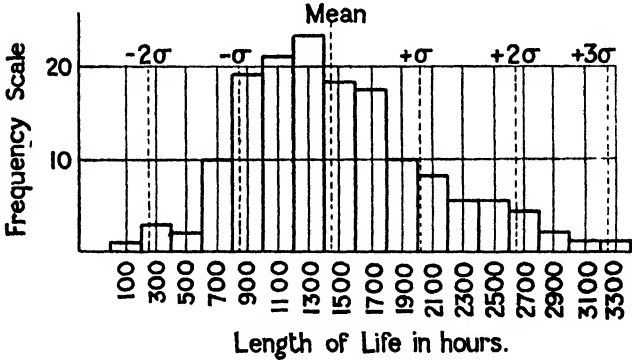
* The form of the 3 frequency distributions of Fig. 1 may be usefully related to the corresponding values of the frequency constants β_1 and β_2 given in Table II below.

FIG.1. FREQUENCY DISTRIBUTIONS.

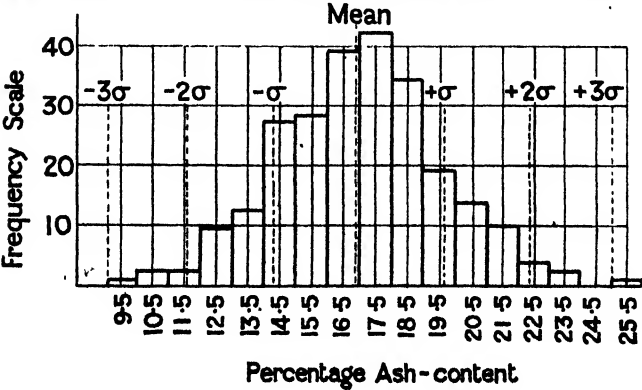
① BREAKING STRENGTH OF CEMENT-MORTAR BRIQUETTES.



② LENGTH OF LIFE OF LAMPS AT MARKED VOLTAGE.



③ PERCENTAGE ASH-CONTENT IN INCREMENTS OF COAL.



by the American Society for Testing Materials we find the following, A.S.T.M. Designation A 47-30, Section 3.

“(a) The tension test specimens specified in Section 5 shall conform to the following minimum requirements as to tensile properties :

Tensile strength, lb. per sq. in.	50,000
Yield point, minimum lb. per sq. in.. . . .	32,500
Elongation in 2 in. per cent.	10.0

”

Consider the property of tensile strength only.

Suppose that of 75 test specimens examined from one source of supply, we were told that 8 failed to reach the 50,000 lbs. per sq. in. limit, and that the mean strength for the 75 was 52,890 lbs. This information might have been sufficient to determine the action of the would-be consumer, but it would have been of relatively little value to the executive of the supplying firm in determining what action to take to improve the quality of production. More information is obtained from an examination of the frequency distribution of the 75 test results shown in Table I, but I want to suggest why further statistical investigation may be worth while.

TABLE I.

Tensile Strength in Malleable Iron Castings.

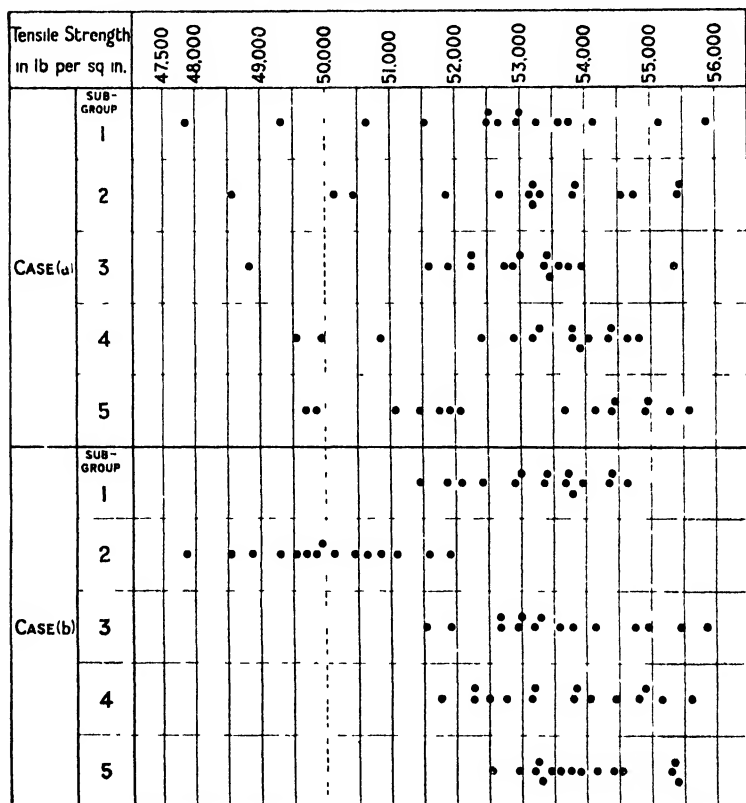
Tensile Strength in lbs. per sq. in.	Frequency.	Tensile Strength in lbs. per sq. in.	Frequency.
47,500-48,000	1	52,000-52,500	4
48,000-	—	52,500-	8
48,500-	2	53,000-	12
49,000-	1	53,500-	11
49,500-	4	54,000-	7
50,000-	2	54,500-	6
50,500-	2	55,000-	5
51,000-	2	55,500-56,000	2
51,500-52,000	6	Total	75

The investigation necessary would demand a consideration of such questions as the dependence of the quality of casting upon choice of materials, homogenization of the mixture, thermostatic control, avoidance of accidental chilling, etc., and it would involve the division of the test records into a number of groups within each of which all or some of these possible factors were constant. This grouping, which is essential in any process of analysis, has been described by W. A. Shewhart as a division into *rational sub-groups*.

Clearly, at this first stage sound judgment coupled with a knowledge of the production process is needed, as distinct from a mere knowledge of statistical technique.

Suppose now that the 75 tests in the present example fall naturally into 5 sub-groups of 15, which it is thought might be differentiated owing to changes in one or other of the factors suggested above. Two

FIG 2. VARIATIONS IN STRENGTH OF MALLEABLE IRON CASTINGS



possible groupings are shown diagrammatically in Fig. 2, where each black spot represents a test value.

Case (a). There is here no obvious differentiation in the spots between the 5 sub-groups; strengths of less than 50,000 lbs. per sq. in. occur in each case. The analysis has not, in fact, provided any evidence that there was a source of trouble present in one group which was not there in the other four.

Case (b). Here the tests in sub-group (2) clearly differ from the rest. That is to say, the failure of the whole 75 tests to pass the

minimum specification has been due to some cause of trouble which it has been possible to locate as operating only on the material from which the tests of sub-group (2) were taken.

The difference between the situations illustrated in the two cases suggests considerations of some importance. If, whatever methods of sub-division are tried, the test values are always scattered more or less without differentiation as for case (a), the only method of raising the minimum level may be to raise the strength value of the whole output, which would mean an increase in the upper limit as well as in the lower. For while the manufacturer may be able to increase the *average* strength, he cannot reduce excessive *variation* without some clue to its main cause or causes. If, on the other hand, some assignable cause of variation can be located as the result of the analysis shown for case (b), the manufacturer may be able to remove the trouble without having to increase his strength throughout. In this way he may secure a higher average strength with a smaller variation about this, as shown for the tests belonging to sub-groups (1), (3), (4) and (5) of case (b).

We may also consider the consumer's point of view. Besides the attainment of a specified standard, it is usually important to him that,

- (1) the quality of the product he receives shall remain uniform from one consignment to another;
- (2) the amount of test sampling he must carry out should be reduced to the minimum consistent with safety.

We may now suppose that the sub-groups in Fig. 2 represent samples tested by him from 5 consignments. In the situation of case (b), the fact that the tensile strength of all 15 test-pieces belonging to the first sample fell above the 50,000 lbs. per sq. in. limit, clearly gives no justification for confidence in the quality of material in a later consignment. Indeed, it is possible that the consumer would prefer case (a), in which a certain margin of strength is sacrificed for confidence in uniformity.

It may be asked, Is there really so much advantage in the uniformity of a product? Does homogeneity from one consignment to another really matter to the extent suggested? The existence of the movement for national and international standardization and the fact that the standardization authorities are not content to rest on what has been achieved, provides one answer to these questions. Reasons not so very different from those which have called for the standardization of the diameters of shafts and the threading of screws, are calling for the standardization of timbers, plasters and cements, bricks and slates, etc. And even where control of variability

has been achieved, it is not always clear that this has been accomplished in the most economic manner. It is likely, for example, that many of the large "safety factors" allowed for in engineering problems could be reduced without any danger, were the variability of constituent parts more carefully analysed.

Let me add two further illustrations, one of a consumer's and the other of a producer's problem.

In lamp production, length of life is an important consideration, and not only is the average life important, but also the variability about the average. It is true that the individual householder is unlikely to notice if the average life of his lamps drops by 100 hours, nor would it matter to him if the standard deviation of life were reduced by 50 per cent. But the matter is more important to a large-scale consumer such as a borough council. If the *variability* is reduced below a certain level, this body may find it a more economic proposition to renew all its street lamps after a fixed number of hours burning, than to wait till each lamp burns out, and then send a man to replace it. But without uniformity in production, no such programme could be planned.

Again, take a problem which might arise in the production of high-grade cotton fabric. Owing to uncontrollable faults, a certain percentage of the lengths turned out by the looms must always be put into a lower quality grade. If this percentage reaches a high figure, the manufacturer is faced with the necessity of disposing of this unwanted burden of low-quality material, which is attached to his high-grade produce as an awkward but unavoidable shadow. Fluctuations in the magnitude of this percentage figure will upset his costing forecasts, but they may also be seized upon as perhaps giving a clue to sources of defect in the weaving system.

These illustrations will have suggested some of the advantages, to both producer and consumer, that may follow from applying tests for homogeneity. It may be questioned: What has statistical method to do with this? Why is not a mere inspection of a diagram such as Fig. 2 adequate? The answer is that in practice all kinds of intermediate situations between those shown in cases (a) and (b) are possible, situations in which the interpretation is not clear from casual inspection. And it is here that more exact methods of analysis are needed.

(3) THE APPROPRIATE METHODS OF STATISTICAL ANALYSIS

Although it would be impossible to treat the subject fully here, a few remarks on the conception of sampling will be helpful. In the first place, in this paper the term sample is used in the statistical as

distinct from the ordinary commercial sense. Thus a sample consists of a number of individual units for each of which one or more characters have been measured and recorded; the measured values are often termed observations, and it is also common to speak of the observations as forming the sample. Thus a *small sample* may consist of 2, 5, 10, etc., units or observations, and a *large sample*, of perhaps 50, 100, 500, etc.

Much of the statistical theory of sampling is based on the assumption that variation arises from what may be termed a constant system of chance causes. If this is so, then when the size of sample is increased, the proportion of individual units having values of a character or characters lying in any given range will (in a statistical sense) approach uniformly a definite limit. A sample drawn under conditions leading to this approach to a limit can be described as a random sample.

From an analysis of samples :

(i) We can test the hypothesis of the constancy of the cause system.

(ii) We can infer certain properties of the limiting form of distribution of the variable characters, and can predict within certain limits what we may expect to find in future samples.

It is not difficult to see the field of application of this theory in industrial problems. In order to use the methods of statistical inference falling under heading (ii), we must be sure that variation in the product is consistent with the assumption of constancy of cause system. Such variation is said to be *statistically controlled*.* For an example, we may turn back to Fig. 2; case (a) suggests that there may be statistical control, but for case (b) this is certainly not present.

The question of whether a sample is representative, is obviously of great importance in dealing with the tests required by specification clauses. The consumer is hardly in a position to know what form lack of control may take. Suppose that he were faced with the question of selecting a sample from a consignment of 10 wagons of boxed material, there being 12 items in a box and roughly 1000 boxes in a wagon. Clearly it would be very difficult for him to devise a satisfactory method of obtaining a representative sample of these 120,000 items unless he knew that the product were controlled, and if the producer could guarantee control, a sampling plan might not be needed. We see, in fact, the value of co-operation between producer and consumer, in order that both may obtain the mutual benefits of control.

* For a much fuller treatment of the subject of sampling and control, the reader must be referred to W. A. Shewhart's book.

A number of statistical tests for homogeneity or control will be discussed in more detail in the following sections. All that need here be noted is that in broad outline these tests involve a division of the measurements or records into groups so chosen as to detect lack of control if it exists.

It should be clear that the methods of analysis which are used must be suited to deal with small groups as well as large. If we are searching for changes with time, the edge of our tool will be blunted if we cannot break up the records into small groups. To class observations into weekly groups may be to miss what is happening from day to day. Critics of small-sample theory are inclined to argue, "What can you infer from two samples of 5? Give us two samples of 100 and we may tell you something!" They do not realize that the distinction is often not of this kind at all. The comparison lies between a technique which can deal with *both*,

(a) 40 samples of 5 (or even 100 of 2), and

(b) 2 samples of 100,

and a technique which can only deal accurately with (b).

Small sample theory is also required in another connection; the consumer judges the quality of the material he is purchasing by the examination of a sample. Such test sampling is also laid down in specification clauses. From the economic point of view, it is often impossible that large samples should be taken; this is particularly so when the test of quality is a destructive one. The buyer of axles, for example, cannot test the breaking strength of a large number; the purchaser of electric lamps cannot afford to burn out more than a limited number in order to test the length of life of his consignment. A clear knowledge of what may be inferred from a small sample regarding the wider whole from which it is drawn is essential. It is equally important to know what *cannot* be inferred, and one of the functions of the statistician is to point out in simple terms just how much information a sampling test gives. The consumer and producer will then be in a position to face the questions, "Is this sampling clause of any value whatever? If it is not, and larger samples are prohibitive, can a more satisfactory system of controlling quality be devised?" It is probable that many of the present sampling tests laid down in specifications are of little value, and it is only the wide margin of safety allowed that prevents an over confidence which might in some cases be dangerous. If the variation in quality were controlled on a sounder basis, this margin of safety could often be reduced, with a resulting economy.

Statistical methods capable of analysing variation within and between small groups have been largely developed and extended by

R. A. Fisher, and fresh problems in the industrial field are already calling for further development of theory on these lines. In the majority of cases, however, the methods are based on the assumption that the variable quantity is "normally" distributed, and it follows that there are two lines of investigation of some importance :

(1) On the practical side to collect and analyse any long series of homogeneous records that are available, and so to increase our knowledge of the types of frequency distribution met in industrial experience.

(2) On the theoretical side to determine what amount of departure from the normal law of distribution may be permitted without modification of the statistical tests used.

TABLE II.

Frequency Constants of Certain Observed Distributions.

Variable quantity measured.	Size of Sample.	β_1 .	$\sqrt{\beta_1}$.	β_2 .
Breaking-strength of cement-mortar briquettes ...	120	0.042	-0.206	2.944
Length of life of lamps at marked voltage ...	150	0.403	+0.634*	3.296
"Wetting time" of cloth ...	150	0.948	+0.974*	4.059*
Percentage ash-content in coal	250	0.004	+0.066	3.239
Resistance in ohms of granular carbon ...	849	0.010	+0.101	3.093
Length of telephone conversations ...	995	0.013	+0.115	3.186
Depth of sapwood in telephone poles ...	1370	0.058	+0.241*	2.687*
Tension in telephone jacks ...	1400	0.030	+0.172*	3.147

* These values appear to differ significantly from the "normal" values of 0 and 3. In all cases but one they fall beyond the 1 per cent. limits of the tables referred to in the text.

To illustrate these points I have collected in Table II values of the frequency constants, β_1 and β_2 for a number of distributions which are not far from being homogeneous. Do these differ significantly from the values $\beta_1 = 0$ and $\beta_2 = 3$ for a normal distribution? Reference to appropriate tables * shows that in certain cases (marked with an asterisk) the difference is clearly significant. We cannot, in fact, escape from the necessity of carrying out the second form of investigation referred to. Certain researches on these lines have already been carried out, others are in progress; and it seems clear

* *Biometrika* XXII, p. 248. *Tables for Statisticians and Biometricians, Part II*, p. 224. I have used the 1 per cent. points of $\sqrt{\beta_1}$ and β_2 to mark the level of significance. Of course the significance of a difference from 0 or 3 depends upon the size of a sample.

that most of the control tests described in the following section may be used without risk of serious error in interpretation, even when the distribution law differs considerably from the normal. This point is discussed further in the Appendix.

At the present stage in the development of this field of application of his subject, the statistician must recognize that the success of his efforts in the direction of helping towards improved efficiency will depend to a large extent on,

(1) The clearness with which he can present to the executive the results of his analysis;

(2) The readiness with which he is prepared to adapt his methods to new problems, and in particular to explore what might be termed second best methods, when the theoretically perfect is either uneconomic or—to take a phrase recently used in this connection—considered by the manufacturer to be too “highbrow.”

For the first purpose—that of clearness—the type of control chart advocated by W. A. Shewhart is admirably suited. These charts are simple to prepare and to interpret, while behind each, as I shall show in the Appendix, lies a more exact test which, if need be, the statistician may himself use to confirm the visual picture he is presenting in the chart.

An instance of the second point—the need for adaptability—I shall illustrate in section (5), on a problem that has arisen in fixing specifications.

If the preparation and interpretation of control charts do not require any extensive statistical training, there will, however, be definite research problems concerned with investigations aiming at improvements in technique or elimination of causes of trouble which will call for the use of more complicated statistical tools. And there is little doubt that sooner or later the industrialist will realize the value of a trained statistician as well as a trained chemist or physicist. In dealing with such problems, many of R. A. Fisher's methods of Analysis of Variance, which are designed to test simultaneously for the presence of a number of factors that may disturb homogeneity, will be of great value.*

(4) CONTROL CHARTS

The division of the records or test measurements into a series of “rational sub-groups” is a preliminary step in the analysis of

* These methods have been used by L. H. C. Tippett in textile research; see, for example, *Shirley Institute Memoirs*, 1929, No. XII, “Statistical Methods in Textile Research. The Analysis of Complex Variations.”

variation. The choice of these groups will depend upon what possible causes of disturbance may be present. The following suggest themselves among others :

(a) Changes with time; in manufacturing or testing technique, in quality of labour, in supply of raw materials, in wear of machines, in humidity or temperature, etc.

(b) Differences which may be present at the same time; non-uniformity in machines or methods of operatives, differences in shop routine, in source of raw materials, etc.

In dealing with cases under (a), our object will often be achieved if the sub-groups consist of separate samples drawn out from time to time during the course of production. But this method of sampling will not always be suitable to detect lack of control due to changes with time. Suppose, for example, that a machine is tuned up once a week, and that its gradual decline in efficiency during the week may affect the quality of production. If then weekly samples were withdrawn for testing, say on Mondays, or on Fridays, no evidence of lack of control would be found. The grouping in this case should be by days of the week, and it would be natural to make a comparison between samples drawn on Mondays, samples drawn on Tuesdays, etc.

For cases under (b), the sub-groups will represent the product of different machines, different operatives, different suppliers of raw materials, etc. We see in both cases the essential need for co-operation between engineer and statistician in the choice of rational sub-groups; or, indeed, what would be better, that the engineer should become statistically minded !

If now it is admitted that there will be variability *within* a sub-group however careful has been the attempt to control conditions, we must ask, How much variability is permissible *between* one sub-group and another? To what extent, for example, may the means of sub-groups differ through chance fluctuations without our being forced to conclude that there is lack of homogeneity? It is here that statistical analysis based on probability theory comes to our assistance and provides us with a measuring-scale to guide our judgment. The purpose of the control chart is to show diagrammatically the observed variation *between* groups set against this measuring scale based on the variation *within* groups. According to the purpose in view, control charts may be formed for the comparison of means, standard deviations, coefficients of variation and correlation, fraction of units defective, etc; and in each case statistical theory provides the appropriate probability measuring-scale.

Two types of problem arise in practice :

Type (1). Here past experience has provided a standard of

quality at which to aim, represented, for example, by a mean value, \bar{a} , and a standard deviation, σ . Our object will then be to discover whether fresh material is conforming uniformly to this standard.

Type (2). Here no standard has been fixed, and the analysis is to be applied to a set of records to discover from internal evidence whether the production is under control or not.

The general lines of treatment are similar, the main difference lying in the fact that: for type (1) \bar{a} and σ are known; in type (2) we must first form from the data estimates of their values, say \bar{a}_e and σ_e , on the hypothesis that the product is controlled, and then, using these estimates, turn round and test the hypothesis.

It would be beyond the scope of this paper to deal with the subject exhaustively, and I must confine myself to the discussion of a few practical illustrations, reserving for an Appendix a summary of the mathematical background which lies behind the diagrammatic presentation of the charts.

Illustration 1.

As was mentioned above, in lamp production it is important to consider not only the average length of life, but also the variability about this average. In the present illustration changes in manufacture were being introduced with a view to improving a past standard of quality represented by a mean length of life at marked voltage of $\bar{a} = 1428$ hrs. and a standard deviation of $\sigma = 535$ hrs.* The aim of the manufacturer was both to increase the average length of life and to decrease the variation relative to this average. After the change in manufacture, samples of 5 lamps were withdrawn at intervals for routine production and tested for length of life by burning to extinction. Changes in the quality of output could be followed by a study of control charts for means and standard deviations, but there is in this case a certain physical significance attached to the coefficient of variation, or the ratio of standard deviation to mean. While length of life will depend upon the strength of current, the coefficient of variation should be independent of this. Consequently, the most forceful way to present the situation appears to be in a chart for coefficient of variation rather than standard deviation. Charts for the three variables are, however, shown for comparison in Fig. 3. For the i^{th} sample let

Mean $= \bar{x}_i$, standard deviation $= s_i$, coefficient of variation $= v_i = s_i/\bar{x}_i$.

* The figures were chosen for the purpose of illustration from records of some years standing supplied by the General Electric Co. Ltd., of England, who have for some time been using statistical methods for control and improvement of mass produced articles.

TABLE III.

Length of Life of Lamps (samples of 5).

Sample No.	Mean.	Standard Deviation.	Coefficient of Variation.	Sample No.	Mean.	Standard Deviation.	Coefficient of Variation.
1	1295	440	0.340	9	1715	385	0.224
2	2005	435	0.217	10	1650	460	0.278
3	2445	580	0.237	11	1935	560	0.287
4	1900	345	0.182	12	1760	280	0.159
5	2570	290	0.113	13	2175	465	0.214
6	1980	510	0.258	14	1570	505	0.322
7	1990	445	0.224	15	1670	380	0.228
8	1990	315	0.158				

These values for 15 samples are given in Table III in the order in which the samples were withdrawn and tested. To judge if there has been any significant change in the length of life, we must compare the variation in \bar{x}_i , and s_i or v_i against control limits determined by the past standard of quality represented by a and σ . On what basis are these control limits to be fixed?

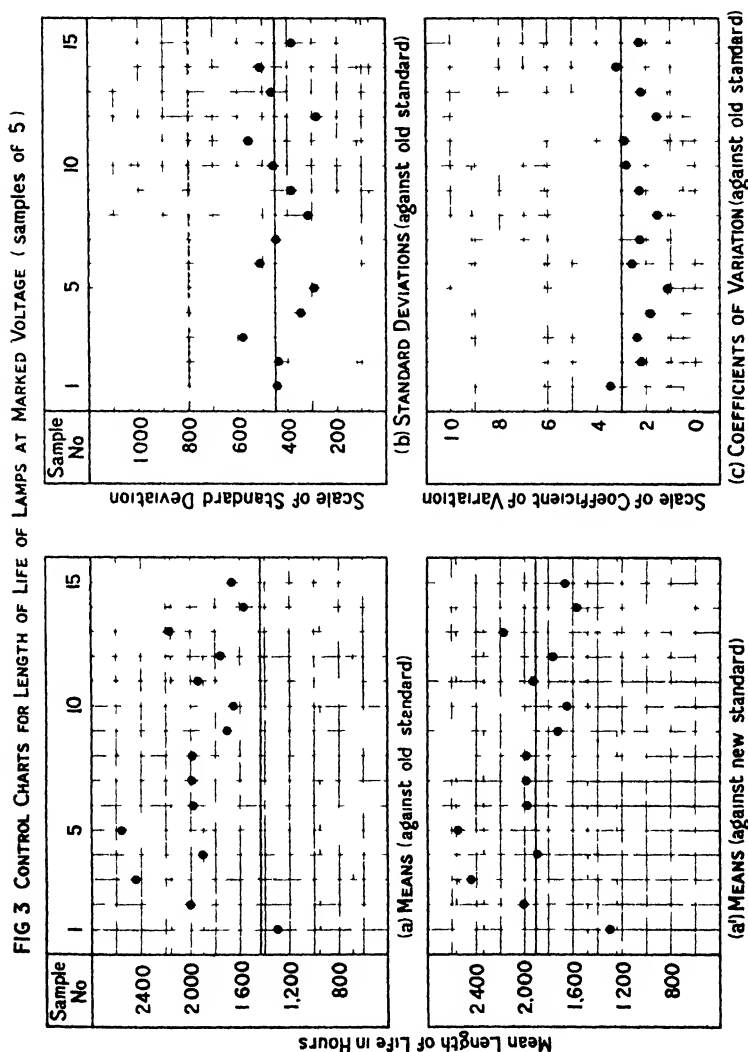
If the length of life at marked voltage among individual lamps were normally distributed,* the sampling distribution of means, standard deviations and coefficients of variation in random samples of n are known. For example, \bar{x}_i should vary normally about a with a standard deviation (or standard error) of σ/\sqrt{n} , whilst s_i follows an asymmetrical law of distribution with known equation. W. A. Shewhart obtains his control limits by adding to and subtracting from the "expected" value three times the standard error. This plan is satisfactory when dealing with the control chart of means, but it is not so in the case of s and v if n be small, for it will often lead to a negative lower limit. Now, the chance of a deviation exceeding three times the standard error is, for normal variation, 0.00135, and for twice the standard error, 0.0228. I would therefore suggest that control limits be fixed on a probability basis rather than in terms of the standard error, and that, following a uniform practice, we should take :

- (1) A pair of outer limits, each of which will be exceeded through chance variation by 1 sample in a 1000 ($P = 0.001$),
- (2) A pair of inner limits for which $P = 0.025$.

If the variation may be assumed to be normal, tables can be formed from which these limits may be readily calculated in any given case; they are given in the Appendix, Table VIII, for the range

* This is not the case (see Table II, and Fig. 8), but judging by the rule suggested on p. 49 of the Appendix, the normal-theory control chart limits may still be used.

$n = 2$ to 10. Fig. 3 shows the spot patterns for \bar{x}_i , s_i and v_i set against these control limits.* If the quality of output had remained controlled at the previous standard, with $a = 1428$ hrs., $\sigma = 535$



hrs., then for each chart we should expect 99.8 per cent. of the sample points to lie within the outer pair of limits and 95 per cent. within the inner pair.

* The calculation of these limits is described in the Appendix.

Before commenting on the charts, certain general points in interpretation must be considered. If the factors determining variation have remained constant from sample to sample— that is to say, if the state of statistical control were perfect—we should expect in the long run about 5 sample points out of every 100 to fall beyond the inner limits, and about 1 in every 500 beyond the outer limits. How is this information to be put into the form of a guide for practical action? Perfect theoretical control is hardly likely to be often attained, even were it an economic proposition. It is natural to ask whether these theoretical probability limits have any meaning under factory and workshop conditions. Empirical evidence to justify their use is necessary. The chief evidence that is available must at present be drawn from the experience of the Bell Telephone System; briefly the working rule there adopted is this :

The critical limits for control are taken at distances of $\pm 3 \times$ standard error from the “expected” value. The occurrence of a point in a chart outside these limits is taken as an indication of a significant variation from standard quality, which should not be allowed to pass. The choice of these limits is not justified on the grounds that it is associated with a particular probability measure ($P = 0.001$), but on the grounds that practical experience has shown that the rule provides a very useful guide to action. In cases where points have fallen outside the limits, sources of trouble have generally been detected on fuller investigation; in other cases where all the points have lain within the limits, investigation has not proved worth while. This conception underlies Shewhart’s term, an *economic* state of statistical control.

The control charts are, of course, valuable for other purposes than checking conformity to a standard, and a careful investigator can often pick up much that is suggestive from a study of the spot pattern *within* these outer limits. For this reason, it seems desirable to add to the charts the inner pair of limits I have described. When, for example, the sub-grouping is in time, the appearance of a succession of spots above (or below) an inner limit may usefully be taken as a warning, if not a positive indication of lack of control.

Return now to the Lamp data. The control limits have been determined on the basis of the previous standard of quality, and we¹ may give a touch of reality to the problem by supposing that, as the testing process on a fresh sample of 5 lamps is completed, a spot is added to each chart. The works manager is watching the picture as it is filled in from time to time, to pick up as soon as possible any clear indication of the result of the change in manufacturing technique. He might perhaps have reasoned as follows :

Chart of Means. (\bar{x}).

Sample No. 1, no change; No. 2, by itself, nothing exceptional; No. 3 (following on No. 2) suggests a change; No. 4, change not yet confirmed; No. 5, improvement in length of life seems highly probable, since the second chart has shown no increase in variability; Nos. 6, 7 and 8 all confirm this view, and the later records all continue above the old mean level.

Chart of Standard Deviations. (s).

No change that could be detected without some more refined analysis (as I have suggested, this chart as well as that for n would not be necessary).

Chart of Coefficients of Variation. (v).

After No. 1, these fall beneath the old median level*; they do not fall below the control limits, but the systematic reduction is evident.

It follows that the change in technique is shown almost certain to have resulted in a decrease in relative variability at the same time as an increase in mean length of life. A further question will then be this: Does the variation among the 15 samples suggest that the production is controlled at the new level? This is a problem of the second type described on p. 33. Estimates a_e and σ_e of new standards must be obtained from the samples. As shown below in the Appendix, they are

$$a_e = 1910 \text{ hrs.}, \quad \sigma_e = 487 \text{ hrs.}$$

From these, new control limits for the means have been found, and are shown in Fig. 3(a'). All the 15 points fall within the outer limits, although 2 lie very near the boundaries.

An interesting point is now raised: we can obtain from what may be termed the *parallel control test* (see Appendix II (i)) a single measure of the probability that the whole set of 15 points would be scattered so widely about a_e , were the control perfect. We find that the chance of as great or a greater amount of scatter, were the product controlled, is given by $P = 0.015$. On a pure probability basis the chances are rather heavily against homogeneity. On the other hand, we have seen that all the means pass the outer control limit test. We see here, I think, the difference between the ideal and economic states of statistical control; the first to be judged by the odds of random sampling, the second on an empirical basis determined by what has been found to pay. Whether Shewhart's limits could be narrowed, experience alone will show.

* See Appendix, p. 52.

Illustration 2.

The previous illustration was of a producer's problem. Consider now the problem of a large firm of consumers who were receiving over a number of years regular consignments of rough slack from a certain colliery. At intervals of about a week, a chemical analysis to determine the percentage ash-content was made on a sample of the coal obtained from a randomly chosen wagon. What method could the consumer use to determine whether the supply was remaining statistically uniform, as far as the proportion of ash-content was concerned? The ultimate practical goal would be to devise a routine scheme for testing the position from week to week, but I shall here confine my attention to a preliminary research problem.

Suppose that 100 values of the percentage ash-content are taken—that is to say, the results of about 2 years' experience—and that the control chart method of analysis is carried out. In order to judge whether there are significant secular changes in quality from time to time, we may compare the means and standard deviations of ash-content in consecutive groups of observations, against control limits. But how are the latter best determined? The standard deviation of ash-content was estimated,

(a) From the whole 100 values grouped together, $\sigma_e = 3.038$ per cent.

(b) From 10 groups of 10 consecutive values, $\sigma_e' = 2.864$ per cent.

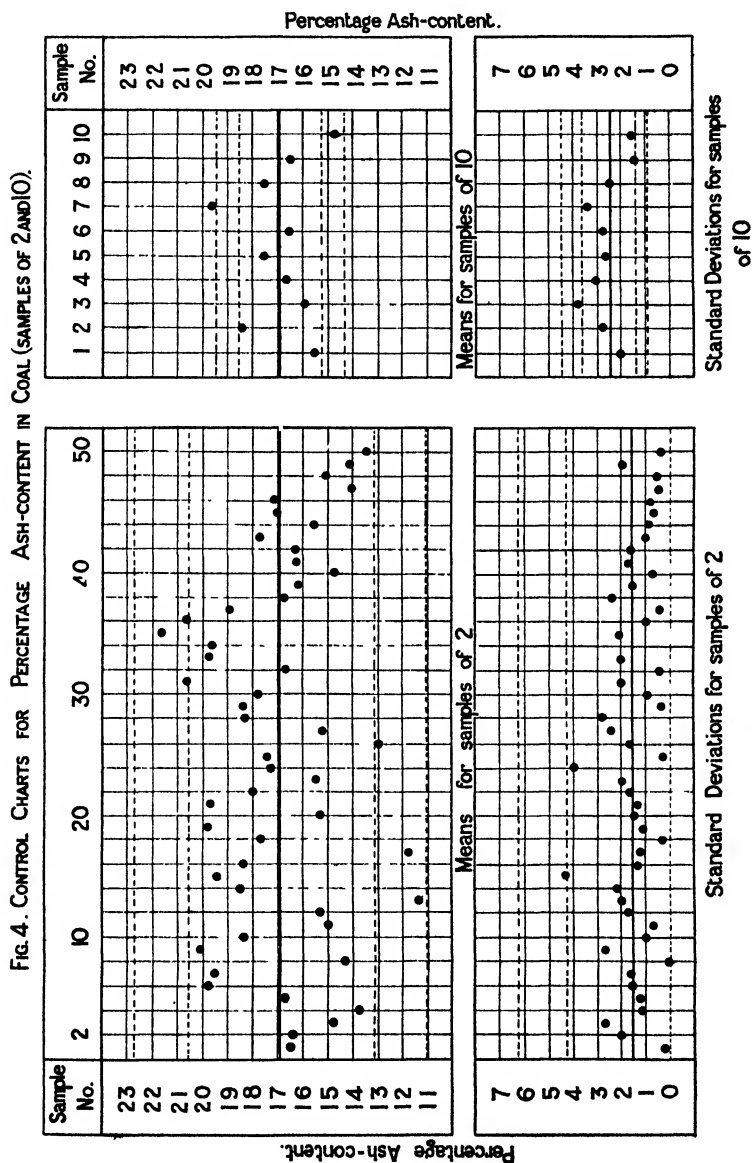
(c) From 50 groups of 2 consecutive values, $\sigma_e'' = 2.683$ per cent.

using for (b) and (c) the equation (2) of the Appendix. Although the differences are hardly significant in a statistical sense, the fact that these values decrease suggests that long-term fluctuations in quality may be present, although they will not be pronounced. The third estimate will be most free from these, and has been used in forming the control limits shown in the four charts of Fig. 4.*

If we use Shewhart's rule, the position of the seventh mean in the chart for samples of 10 suggests definite lack of control; on turning to the chart for means of 2, we can see more clearly what is happening. After a rise to a high value, there is a systematic fall in ash-content from the thirty-fifth sample onwards, and this fall in means is associated with a reduction in variability. The possibility of the changes being in part due to alterations in the technique of laboratory analysis would, of course, have to be considered. Apart from this, it

* The use of samples of 2 for estimating variation freed from time changes was discussed by "Student" in a paper on "Errors of Routine Analysis," *Biometrika XIX*, pp. 151-164.

is likely that the phenomena could be related back either to alterations in the mining process or to changes in the formation of the coal seam.



These are points for the technical expert to decide; the purpose of the statistical analysis is to provide evidence to guide his judgment.

Illustration 3.

So far I have discussed only the control of a single measure of quality taken in isolation from others. But it will sometimes be important to consider the relationship between two or more qualities; that is to say, we may be concerned with the control of co-variation as well as of variation. An interesting example arises in the case of tests of quality which are destructive; such, for example, are tests of breaking strength. In dealing with certain metal products, a measure of hardness is sometimes used as an index of tensile strength. If, however, we are to predict strength from hardness, using the correlation method, it is clearly essential that the degree of relationship between these two qualities shall remain stable. It must not change from one plant to another or from one month to the next; in fact, not only the mean and variation about the mean, but the correlation coefficient also needs to be subjected to control analysis.

TABLE IV.
Correlation Data for Aluminum Die Castings
(Samples of 12.)

Sample No.	Tensile Strength (lbs per sq in.)		Hardness (Rockwell's E).		Coefficient of Correlation.
	Mean	Standard Deviation.	Mean	Standard Deviation.	
1	33,399	2565	68.49	10.19	0.683
2	28,216	4318	68.02	14.49	0.876
3	30,313	2188	66.57	10.17	0.714
4	33,150	3954	76.12	11.08	0.715
5	34,269	2715	69.92	9.88	0.805
6	—	—	—	—	—
∴	—	—	—	—	—

The type of problem is illustrated by the data given in Table IV, which is based on measurements of, (a) tensile strength in lbs. per sq. in., and (b) hardness in Rockwell's "E" made on test specimens of a certain aluminium die-casting.* The data have been divided into samples of 12, for each of which two means, two standard deviations and a coefficient of correlation are shown; were more data available control charts could be formed for each of these five quantities.

Illustration 4.

A variable quantity of another type to those we have considered is the number or fraction of units in a sample bearing a certain characteristic, such, for example, as the fraction of units defective.

* The data are taken from W. A. Shewhart's *Economic Control of Quality of Manufactured Product*, p. 42.

At early stages in mass production it will often be more economic to allow a certain number of defective parts to slip through to a later stage in assembly, rather than attempt 100 per cent. inspection, provided that the fraction defective is kept below a certain level. That this result is being attained may be checked by spot sampling, and the problem then becomes one of testing whether the fraction defective is statistically controlled.

TABLE V (a).
Defective Units in 12 Samples of 400 Articles.

Sample No.	1.	2	3.	4	5	6	7.	8.	9.	10	11.	12
Units defective ...	8	4	3	3	2	6	4	2	3	10	1	5

TABLE V (b).
Terms of Binomial $(q + p)^{400}$. $p = 0.010625$.

b = number defective in 400.	0.	1	2.	3.	4.	5.	6.
Chance of b ...	0.0139	0.0599	0.1283	0.1828	0.1949	0.1657	0.1172
Chance of b or less	0.0139	0.0738	0.2021	0.3849	0.5798	0.7455	0.8627
b = number defective in 400.	7.	8	9.	10.	11.	12.	13 or more.
Chance of b ...	0.0708	0.0374	0.0175	0.0073	0.0028	0.0010	0.0005
Chance of b or less	0.9335	0.9709	0.9884	0.9957	0.9985	0.9995	1.0000

Table V shows the results of 12 series of inspection tests each carried out on 400 articles; in all 51 articles out of 4800 were defective, or a fraction 0.0106. Is the variation in this fraction from series to series such as to suggest that the chance of defect is not remaining constant? If it were clearly not constant, that is to say there was evidence of heterogeneity or lack of control:

(a) No safe conclusions could be drawn as to the amount of defect in material outside the samples actually inspected.

(b) It would probably be worth while attempting to track down the causes of excessive variation.

The numbers of defective articles have been plotted in Fig. 5, and the usual pair of control limits are shown. These have been obtained as described in the Appendix from the binomial expansion $(q + p)^n$, where $n = 400$ and $p = 1 - q = 0.0106$.

It appears from the chart that the fraction defective may be considered in this case to be under control.

Schemes for sampling inspection at various stages in production have been widely adopted in the manufacturing section of the Bell Telephone System.* In some cases the rules laid down involve the drawing of a second sample, when the fraction defective in the first exceeds a certain limit. To the applied mathematician there is considerable fascination in this application of probability theory to determine how best to adjust, from the economic point of view, the fineness of the inspection sieve to be used at each successive stage of manufacture and assembly.

(5) A SPECIFICATION PROBLEM

Specifications are required to distinguish between the good and the bad: the article which is suitable for a purpose and that which is not. If every article or unit were inspected, or if all of them in a given lot were identical in character so that the inspection of one were all that was necessary, it would be possible to distinguish with certainty between the good and the bad. Actually we cannot do this, since there is variation from one article to another, and 100 per cent. inspection is generally out of the question. But provided that the production is under control, we can arrange by the inspection of a sample that the chance is exceedingly small

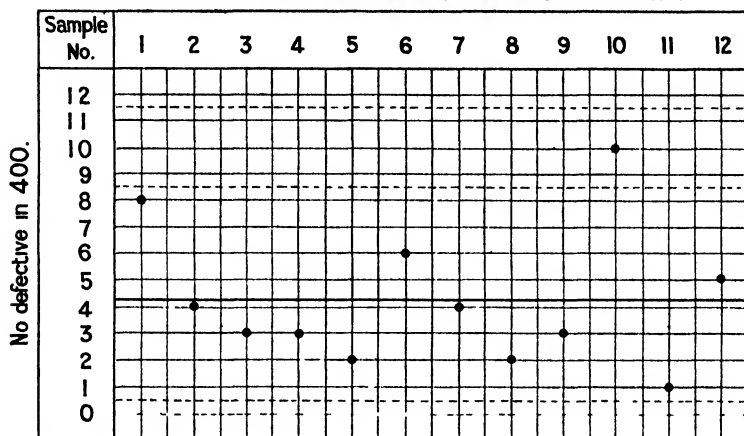
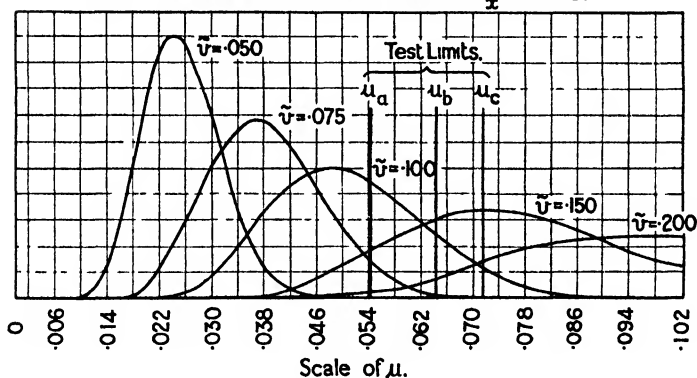
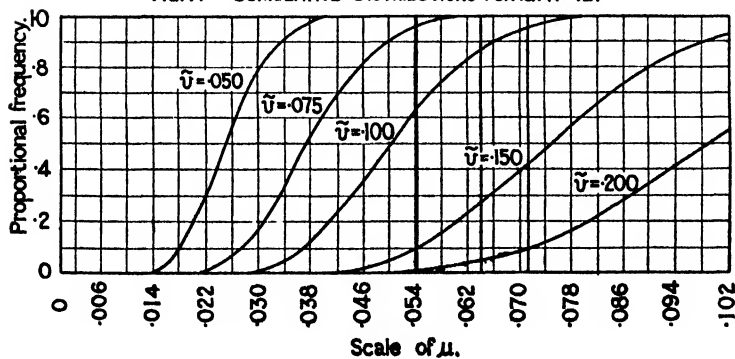
- (a) Of passing material of quality below a certain standard,
- (b) Of rejecting material of quality above another standard.

A necessary part of a specification is therefore a rule of procedure for sampling and testing, and it is both important that these testing rules should be devised in the most effective manner, and essential that steps should be taken to secure a representative sample.

We may determine the testing rule so that a manufacturer whose material is at or above a certain standard is very unlikely to be penalized by rejection. This standard will be associated with a risk of rejection, ϵ . It may be termed the *producer's* effective level or safety level, since in order to reduce to ϵ or less the risk of his sample failing to pass specification, he must keep the quality of output up to or above this level. Material of quality below the producer's effective level will often pass specification; but the chance of acceptance will decrease as the quality falls until finally a level is reached such that the chance is now ϵ' , or less, that a sample from material at or below this standard will be accepted. We may term this second standard the *consumer's* effective level or

* The basis of some of these schemes is described by H. F. Dodge and H. G. Romig in the *Bell System Technical Journal*, VIII, 1929, pp. 613-631, in an article entitled "A Method of Sampling Inspection."

FIG. 5. CONTROL CHART FOR FRACTION OF DEFECTIVE PARTS.

FIG. 6 SAMPLING DISTRIBUTIONS FOR $\mu = \frac{\bar{x} - \bar{x}_s}{\bar{x}}$, $n=12$.FIG. 7. CUMULATIVE DISTRIBUTIONS FOR μ , $n=12$.

safety level, since his risk of receiving material of quality below this level is not more than c' .

Between the consumer's and producer's effective levels there lies a belt of uncertainty, which it is clearly desirable should be as small as possible, for on this depends the efficiency of the specification. This efficiency may be increased :

- (1) By increasing the size of sample tested.
- (2) By fixing rules for a second sample to be drawn when the first fails to pass a certain standard.
- (3) By choosing, from possible alternative testing rules, that which reduces the belt of uncertainty to a minimum.

The following example will illustrate some of these points. It has already been suggested that in certain problems the coefficient of variation has a definite physical meaning. In the case of cement mixing, for example, the mean and standard deviation of strength will depend upon the way of mixing, the speed of setting, the temperature, etc., but the coefficient of variation may be independent of these factors. Consequently it is desirable to take this ratio of standard deviation to mean as one characteristic of quality to be considered in specifications.

In discussing with manufacturers the testing rule to be adopted, while the obvious criterion to use seemed to be the sample coefficient variation, $v = s/\bar{x}$, it was found that certain practical—shall I say diplomatic—considerations necessitated the use of a simpler criterion. Such was obtained as follows: let the sample size, n , be a multiple of 3; arrange the observations in order of magnitude and find as well as the mean, \bar{x} , the mean of the lower two-thirds of the n values, say \bar{x}_2 . Then

$$u = \frac{\bar{x} - \bar{x}_2}{\bar{x}}$$

was the criterion suggested. At first glance it may appear absurd to suggest the use of u in place of v , yet it is very instructive to examine the problem a little more closely. If the distribution law for x be normal with mean, a , and standard deviation, σ , the sampling distribution of u (as that of v) must depend only on the sample size n and the coefficient of variation $\bar{v} = \sigma/a$, in the sampled universe. Distribution curves for u were first obtained experimentally, and certain of these are shown in Fig. 6 for samples of 12, and for the cases $\bar{v} = 0.050, 0.075, 0.100, 0.150, 0.200$.

Suppose now that we start from the consumer's end of the problem and fix testing rules so that samples of 12 from material having $\bar{v} = 0.200$ will only pass specification

- (a) 1 time in 100 ($\epsilon' = 0.01$);
 (b) 1 time in 20 ($\epsilon' = 0.05$);
 (c) 1 time in 10 ($\epsilon = 0.10$).

It is found from the empirical sampling curves that the three corresponding testing rules will be as follows: Reject when,

- (a) $u > u_a = 0.0542$; (b) $u > u_b = 0.0647$; (c) $u > u_c = 0.0711$.

These three discriminating levels are shown in Fig. 6.

Since the distribution curves overlap very considerably, these rules will lead to many rejections in cases where the sampled material has $\bar{v} < 0.200$. The integral curves drawn in Fig. 7 show the position even better than the distribution curves, and if drawn on a large scale provide a ready method of reading off the percentage rejections for different values of ϵ' . The situation is summarized in Table VI. It is clear that if we reduce to 0.01 the consumer's risk,

TABLE VI.
Effect of u -Test.

Discriminating Value.	Percentage Rejections if .			Percentage Acceptances if $v = 0.200$.
	$\bar{v} = 0.075$.	$\bar{v} = 0.100$.	$\bar{v} = 0.150$.	
$u_a = 0.0542$	4.3	37.3	90.0	1.0
$u_b = 0.0647$	0.2	12.8	72.5	5.0
$u_c = 0.0711$	0.0	5.1	58.3	10.0

ϵ' , with regard to material having $\bar{v} = 0.200$, the producer's effective level must be set very far below this value. A producer whose material has $\bar{v} = 0.075$ will still be likely to incur 4.3 per cent. of rejections.

I have already indicated methods that might be employed to reduce this belt of uncertainty; one involves the drawing of a second sample in certain cases. Suppose that the following testing rule were fixed:

- Reject if $u > u_c = 0.0711$.
 Test a second sample if $u_c = 0.0711 > u > 0.0542 = u_a$.
 Accept if $u < u_a = 0.0542$.

The result is shown by the figures in bold type in Table VII. Before discussing these figures, we may consider in what way the use of v instead of u would lead to a more efficient testing rule. Increased efficiency, if it exists, would arise because the sampling curves for v would overlap one another less than the corresponding curves for u shown in Fig. 6. In other words, a testing rule based

TABLE VII.
Comparison of u and v -Tests.

Percentage of Tests resulting in :	Test Criterion used.	Quality of Output.			
		\bar{z} 0.075.	r 0.100.	\bar{z} 0.150.	r 0.200.
Complete acceptance.	$\begin{cases} u \\ v \end{cases}$	95.7 <i>96.7</i>	62.7 <i>62.5</i>	10.0 <i>8.8</i>	$\left. \begin{array}{l} \\ \end{array} \right\} 1.0$
Further sampling.	$\begin{cases} u \\ v \end{cases}$	4.3 <i>3.3</i>	32.2 <i>34.8</i>	31.7 <i>35.9</i>	$\left. \begin{array}{l} \\ \end{array} \right\} 9.0$
Complete rejection.	$\begin{cases} u \\ v \end{cases}$	0.0 <i>0.0</i>	5.1 <i>2.7</i>	58.3 <i>55.3</i>	$\left. \begin{array}{l} \\ \end{array} \right\} 90.0$

on v would discriminate between good and bad quality more effectively than a rule based on u .*

The work of A. T. McKay, confirmed by E. C. Fieller,† has made it possible to obtain a very good approximation to the sampling distribution of v . Using this, we may find two discriminating values $v_a = 0.0994$ and $v_c = 0.1349$ which cut off 1 per cent. and 10 per cent. respectively from the distribution of v when the sampled universe has a coefficient of variation, $\bar{v} = 0.200$. From these it is possible to obtain the percentage rejections and acceptances in the cases $\bar{v} = 0.075$, 0.100 and 0.150 as was done when using u as criterion. The results are shown by the italic figures in Table VII.

This form of summarized presentation readily suggests a number of questions which are typical of those that should be raised in determining the sample tests to be included in a specification.

(1) How do these figures appeal to the manufacturer? Does this testing rule appear to serve the purpose of discrimination between good and bad quality that is needed? How might it be modified? If it is adequate, might the sample size be reduced below 12? If inadequate, is he prepared to let the size be increased?

(2) Relative efficiency of u and v . There is surprisingly little difference between the efficiency of the two criteria, but the table shows a small advantage to v .‡ For example, the manufacturer whose material has a coefficient of variation of 0.100 will risk complete rejection on about 5 per cent. of samples when the test is based

* We meet here a very fundamental statistical problem that arises in choosing the most efficient criterion for testing hypotheses. This conception of the efficiency of a criterion in discriminating between the false and the true hypothesis is closely related to certain principles in the logic of statistical inference, developed by J. Neyman and the present writer in a paper which is being published elsewhere.

† R.S.S. JOURNAL, XCV, Part IV, 1932, pp. 695-702.

‡ Too much stress must not be laid on the exact values of the percentages for the u -test, since the curves have been derived by empirical methods only.

on u , and on only about 3 per cent. when it is based on v . Does the greater simplicity in the calculation of u balance this loss?

(3) Where a second sample is needed, of what size shall this be, and what testing rule is to be applied to the result?

(4) Assumptions involved. Is the distribution law of the quality, x , near enough to the normal to justify the use of this theory? Can random sampling be assured and is the product controlled?

These are some of the points that need to be thrashed out on a specification committee, but without some preliminary statistical investigation, it should be evident that there can be no solid foundation on which to build.*

(6) CONCLUDING REMARKS

In the preceding sections I have used a number of illustrations to outline the contribution, as I see it, which statistical analysis can give to modern industry. This contribution has two important aspects; it provides,

(1) A scientific basis for the establishment of economic standards of quality.

(2) An essential tool for the manufacturer in his effort to maintain those standards and to increase efficiency in production.

It is because we find from so many view-points that the economic goal at which to aim in production must be expressed in terms of quality which is statistically controlled, that I have laid particular emphasis on the methods of control testing. These are fundamental; but there are, of course, other methods, besides those which I have mentioned, that will often be of value.

I have referred to the quality of labour as one factor affecting production, but have purposely not attempted to discuss the important field of industrial psychology. It is clear, however, that statistical methods, which are shaped to analyse any form of variation, are as essential to the psychologist as to the engineer and the chemist.

The question of cost is often raised as an objection to the introduction of new methods. To this it can be answered that in many cases the test records required are already collected as a matter of routine, but are filed away unused, often to be destroyed upon

* In trying to show the bearing of certain important conceptions in theoretical statistics on problems of specification, I fear I may have expressed myself in this section in rather too technical a form. But it would not be difficult to restate these points in a manner that should be readily understood by manufacturers on a specification committee.

accumulation; that the cost of statistical treatment is a relatively small item after the records have been taken, and that there are a number of firms who have accepted the risk of initial expenditure and have been well repaid by the ultimate gain. Indeed, the present survey will have achieved something of value if it calls attention to the fact that the methods described are being used, here and there, by practical industrialists.

From the standpoint of the statistician, I have tried to indicate certain of the problems needing solution. There are some which involve hard but straightforward calculation, such as testing the adequacy of approximations and preparing tables in most convenient form for ready use. But there are also others of equal importance which lie on that border region where the mathematical statistician is exploring the unknown.

In our present *impasse*, when the remedies discussed cover the whole world system of exchange and supply, these wares that I have set out may perhaps be thought of small account. Yet I am confident that whatever be the immediate or ultimate solution of world economic problems, it must include the development of methods which seek both to eliminate the waste of energy in production, and to supply goods soundly made and such as are best fitted to satisfy our human wants. These are the aims of scientific method, and in this case the scientific is necessarily the statistical.

APPENDIX

THE MATHEMATICAL BACKGROUND OF THE CONTROL CHARTS AND TESTS

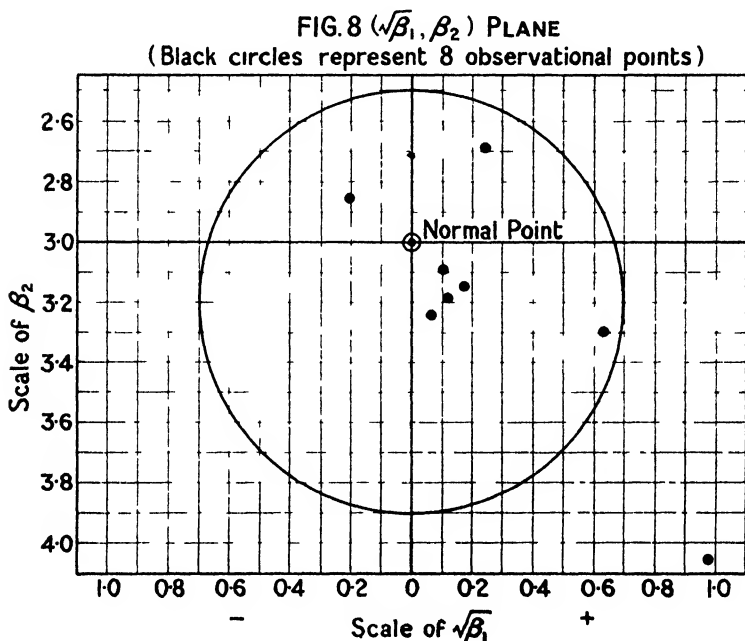
The probability limits for each control chart are determined from the sampling distribution of the corresponding statistical estimate. In all cases except that associated with the binomial (*I*(vi) and *II*(vi)) the theory is based upon the assumption that within a homogeneous group the varying character or quality, x , follows the normal law of distribution,

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{1}{2}\frac{(x-\mu)^2}{\sigma^2}} \quad . \quad . \quad . \quad . \quad (1)$$

But from a variety of evidence which is available, mainly of an experimental character, it seems clear that from the practical point of view the tests may be safely used when the form of variation differs considerably from the normal. I must admit that the nature of the problem makes it very difficult to define the expressions "safely used" and "differs considerably." From the point of mathematical exactitude, two probability distributions may differ

considerably, and yet as a guide to practical action one may be safely used as an approximation to the other.

One method of defining the issue is as follows. Experience has shown that the great majority of observed unimodal frequency distributions can be represented adequately by members of a single system of mathematical curves, such as the Pearson-type curves, whose shape is completely defined by the two frequency constants $\sqrt{\beta_1}$ and β_2 . On this hypothesis any distribution law may be represented by a point in a plane with rectangular co-ordinates



($\sqrt{\beta_1}, \beta_2$), and any region in this plane will therefore be associated with a set of distribution laws. Is it, then, possible to suggest any working rules indicating that when the variation in quality follows a distribution law whose ($\sqrt{\beta_1}, \beta_2$) point falls in a prescribed region, this test or tests may be used?

At the present stage of my own investigations I am inclined to hazard the opinion that if a circle be drawn in this plane with centre at the point, $\sqrt{\beta_1} = 0$, $\beta_2 = 3.2$, and with a radius 0.7, then for variation associated with the region contained in this circle, the control chart limits to be described below may be used even if the sub-grouping is into samples containing only five or six observations. But I suggest this only as a tentative conclusion which is in the course

of being put to a fuller testing, and it may well be found advisable to reduce the radius of the circle. Fig. 8 shows this circular region and also the $(\sqrt{\beta_1}, \beta_2)$ points of the distributions listed in Table II. It must be remembered that these β values have been calculated from samples, three of which contain less than 200 observations; they must therefore be considered as liable to varying degrees of sampling error.

I. Calculation of Control Chart Limits.

Suppose that N observations of a variable quantity x , are divided into k sub-groups or samples, and that the t^{th} group contains n_t observations, with

$$\begin{aligned}\text{Mean} &= \bar{x}_t, \text{Standard deviation} = s_t,^* \\ \text{Coefficient of variation} &= s_t/\bar{x}_t = v_t.\end{aligned}$$

The values of the mean, a , and standard deviation, σ , of the distribution-function (1) are either determined from past experience, or may be estimated from the data (problems of types (1) and (2) of pp. 32, 33 above). In the latter event we may use in the charts,

$$\left. \begin{aligned} a &= \frac{1}{N} \sum_{t=1}^k (n_t \bar{x}_t) \\ \sigma^2 &= \frac{1}{N-k} \sum_{t=1}^k \sum_{i=1}^{n_t} (x_{ti} - \bar{x}_t)^2 = \frac{1}{N-k} \sum_{t=1}^k (n_t s_t^2) \end{aligned} \right\} \quad (2)$$

The construction of charts based on σ_t is, however, not satisfactory if $N - k$ is, say, less than 30.

I shall suppose that in each case a pair of outer control limits is to be taken at the probability levels $P = 0.001$, and an inner pair at $P = 0.025$. In any planned investigation, it is generally possible to arrange that the number of observations in a group is kept constant, or that

$$n_t = n = \text{constant } (t = 1, 2 \dots k) \quad (3)$$

For this reason and because of the resulting simplicity in treatment, the following discussion will be restricted to the case in which (3) is

* If x_{ti} be the i^{th} value of x in the t^{th} sample, then s_t is here defined by the relation

$$s_t^2 = \frac{1}{n_t} \sum_{i=1}^{n_t} (x_{ti} - \bar{x}_t)^2.$$

This division of the sum of squares by n , rather than $n_t - 1$ is likely to be criticized by some. Let me first point out that no error is involved; that s^2 is on the average less than σ^2 in small samples (only half its value when $n = 2$) is not a difficult conception to grasp. The base line (mean s) and limits in the control chart for s are fixed accordingly. When an estimate of σ^2 is needed, the bias may be corrected as in equation (2). What is of real importance from the view-point of international industrial standardization is that a common practice should be established in this and in other countries.

true. If n_i is not constant, limits can still be shown in the charts, but they will not be straight lines.*

(i) *Control Limits for Means.*

If there is perfect theoretical control, \bar{x}_i should be distributed normally about a with a standard error of σ/\sqrt{n} . Consequently we should draw,

$$\left. \begin{array}{l} \text{Outer control limits at } a \pm 3.0902\sigma/\sqrt{n} = a \pm A_{0.001} \sigma \\ \text{Inner control limits at } a \pm 1.9600\sigma/\sqrt{n} = a \pm A_{0.025} \sigma \end{array} \right\} \quad (4)$$

where the constants A are given in Table VIII for $n = 2$ to 10.

(ii) *Control Limits for Standard Deviations.*

If there is perfect control, the sampling distribution of s_i follows the well-known law whose probability integral can be obtained either from the tables of the χ^2 integral,† by writing

$$\chi^2 = ns^2/\sigma^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

and entering the tables with $n - 1$ degrees of freedom; or from the Tables of the Incomplete Gamma Function,‡ where

$$p = \frac{1}{2}(n - 3), u = ns^2/(2\sigma^2\sqrt{p + 1}) \quad . \quad . \quad . \quad (6)$$

If we write the control limits as follows,

$$\left. \begin{array}{l} \text{Outer control limits at } B_{0.001} \sigma \text{ and } B_{0.999} \sigma \\ \text{Inner control limits at } B_{0.025} \sigma \text{ and } B_{0.975} \sigma \end{array} \right\} \quad (7)$$

Mean s at $B_m \sigma$

the constants B , except B_m , can be found from the tables by backward interpolation. The process is a little laborious, and it would be clearly desirable to extend Table VIII, in which I have given values of the B 's for $n = 2$ to 10. If n is greater than 30 we may reasonably assume s to be normally distributed about σ , with a standard error of $\sigma/\sqrt{2n}$, and take limits at

$$\sigma \pm 3.0902\sigma/\sqrt{2n} \text{ and } \sigma \pm 1.9600\sigma/\sqrt{2n}.$$

The control chart might, of course, have been formed for s_i^2 instead of s_i . The latter was chosen because the linear measure of variation has a significance more readily grasped by the non-statistician.

* Charts of this type may be seen in W. A. Shewhart's *Economic Control of Quality of Manufactured Product*, p. 310.

† As, for example, in *Tables for Statisticians and Biometricians*, Pt. I. Table XII (issued by the Biometric Laboratory). Here n' = sample size = number of degrees of freedom + 1 = $f + 1$. Or in R. A. Fisher's *Statistical Methods for Research Workers*, Table III; in his notation n = sample size - 1 = number of degrees of freedom = f .

‡ *Tables of the Incomplete Gamma Function*, H.M. Stationery Office, 1922.

(iii) *Control Limits for Coefficients of Variation.*

Recent work by A. T. McKay * has shown that an approximation to the sampling distribution of v may be obtained from the χ^2 distribution by writing

$$\chi^2 = n \left(1 + \frac{\sigma^2}{\sigma^2} \right) \frac{v^2}{1 + v^2} \quad (8)$$

and entering the tables of χ^2 with $n - 1$ degrees of freedom. It follows that the probability levels found for s may be used to obtain those for v . In fact, they may be obtained from the equations,

$$v = 1 / \sqrt{C \left(1 + \frac{\sigma^2}{\sigma^2} \right)} - 1 \quad (9)$$

where

$$C_{0.001} = 1/B_{0.001}^2, C_{0.025} = 1/B_{0.025}^2, \text{ etc.} \quad (10)$$

Values for $C_{0.001}$, $C_{0.025}$, $C_{0.975}$, $C_{0.999}$ are given in Table VIII from $n = 5$ to 10. I am not clear of the accuracy of the approximation for $n < 5$ or for $\sigma/a > \frac{1}{3}$. The mean value of the true sampling distribution of v appears to be infinite, and the most satisfactory central value to enter in the control chart is perhaps the median, an approximation to which may be obtained from the median χ^2 through (8). The values of C_{mt} shown in Table VIII for $n = 5$ to 10 will give this approximation when used in (9).

Example of use of Table VIII; Lamp data (Illustration 1, p. 33).

Case (1). Standard of quality obtained from previous experience, and represented by

$$a = 1128.4 \text{ hrs.}, \sigma = 534.9 \text{ hrs.}$$

Taking from the Table the appropriate values of A , B and C for $n = 5$, the limits shown in Fig. 3 (a), (b) and (c) are obtained from relations (4), (7) and (9), respectively.

Case (2). Values for a and σ to be estimated from the 15 samples a_e and σ_e must be found from equations (2), where

$$N = 75, k = 15, n_i = \text{constant} = n = 5.$$

Note that $N - k > 30$. It is found that

$$a_e = 1910.0 \text{ hrs.}, \sigma_e = 487.1 \text{ hrs.}$$

These values have been used to obtain the control limits for the means in Fig. 3 (a').

(iv) *Control Limits for Range.*

By the range in a sample of n , I mean the difference between the greatest and the least values among the n observations. In

* Already referred to in section (5), p. 46.

small samples range is highly correlated with standard deviation,* and at any rate for purposes of rapid investigation, it may prove a useful substitute for the latter in controlling variation. In a paper just published,† I have given a table of approximate percentage limits of the distribution of range in samples from a normal population, from which control charts may be formed. But because of the relative simplicity with which range can be calculated, it would be a little dangerous to advocate its use as a common tool before fuller information on its reliability has been collected.

(v) *Control Limits for Coefficients of Correlation.*

The problem in simplest form is this: observations on two correlated characters have been divided into k rational sub-groups giving coefficients of correlation r_1, r_2, \dots, r_k . Is the variation among these r 's consistent with the hypothesis of statistical control? In problems of Type (1), a standard value for the correlation, ρ , has been fixed from previous experience. For problems of Type (2), a value ρ_e must be estimated from the data. A crude method of procedure is to take the weighted mean value, or

$$\rho_e = \frac{\sum_{i=1}^k (n_i r_i)}{N}. \quad \dots \quad (11)$$

R. A. Fisher has suggested a method of weighting based on the z -transformation which appears more satisfactory.‡ The sampling distribution of r , if n be small, is so far from normal§ that the use of symmetrical control limits (as for means) based on a standard error of

$$\sigma_r = (1 - \rho^2)/\sqrt{n-1} \quad \dots \quad (12)$$

is not satisfactory. Limits may, however, be obtained from the normal probability integral if Fisher's transformation is used, and should the control of r become a common standard practice, tables for facilitating the determination of these limits for $P = 0.001$ and 0.025 could certainly be prepared.

(vi) *Control Limits for Fraction Defective.*

Suppose that b individuals in a sample of n have a character A , e.g. b out of n are defective. The problem is to distinguish between situations in which there is a stable cause system determining the

* For samples of 5 the correlation coefficient appears, for example, to be over + 0.95.

† *Biometrika*, XXIV, pp. 404-417.

‡ *Metron*, Vol. I, N. 4 (1921), p. 17. For the z -transformation see his *Statistical Methods for Research Workers*, Section (35).

§ The frequency constants of the sampling distribution and ordinates of the curve are given for a wide range of cases in *Tables for Statisticians and Biometricians*, Part II. Tables XXXI and XXXII.

presence or absence of A , and others in which the system is unstable, or not under control. In the first case we say that the chance, p , of an individual unit taken at random bearing the character A remains constant. If this be so, then in repeated random samples of n , b will be distributed according to a frequency law whose terms are given by the binomial expansion $(q + p)^n$, where $p = 1 - q$. The observed values of b may be plotted in a control chart, as in Fig. 5, but since they must assume integral values it will not in general be possible to draw limiting levels corresponding exactly to $P = 0.001$ and 0.025 . Approximate positions for the limits may be obtained, however, either by calculating the required number of terms of the binomial, or if p be small and n large from Poisson's limit to the binomial, the terms of which have been tabled.*

The moment coefficients of the terms of the binomial expansion are

$$\begin{aligned} \text{Mean } b &= np; \text{ Standard deviation of } b = \sqrt{npq} \\ \beta_1 &= (1 - 4pq)/(npq), \beta_2 = 3 + (1 - 6pq)/(npq) \end{aligned} \quad (13)$$

If neither p nor n be too small, β_1 and β_2 will approach the values of 0 and 3 respectively, and limits may be drawn at

$$np \pm \lambda \sqrt{npq} \quad (14)$$

where the multipliers, λ , can be taken from the normal probability scale, viz.,

for outer limits $\lambda = 3.0902$, for inner limits $\lambda = 1.9600$.

In dealing with fraction defective, however, p will generally be a small number, perhaps of order 0.01, and unless n be very large the sampling distribution of b will be far from symmetrical.

In the example described above (p. 41 and Table V) p must be estimated from the data. If there are k samples each of size n , so that $N = kn$, we take

$$p_c = \sum_{i=1}^k (b_i)/N \quad (15)$$

and in this case find

$$p_c = 51/4,800 = 0.010625.$$

Hence if there be control, we should have for the sampling distribution of b

$$\begin{aligned} \text{Mean} &= 4.25 & \text{Standard Deviation} &= 2.0506 \\ \beta_1 &= 0.2278; & \beta_2 &= 3.2228. \end{aligned}$$

This distribution is clearly not symmetrical, and the limits suggested in (14) could not be used. The terms of the binomial for which $p = 0.010625$ and $n = 400$ are shown in Table V as well as the

* See, for instance, *Tables for Statisticians and Biometricians*, Pt. I, Table LI.

cumulative totals. A very good approximation to these values could be obtained by interpolating in the Tables of the Poisson function referred to above with

$$m = \text{mean} = 4.25$$

The outer limits for the control chart may now be taken at $b = 0$ and between $b = 11$ and 12 ; the inner limits between $b = 0$ and 1 , and between $b = 8$ and 9 .

II. *The Parallel Control Tests.*

These tests indicate in terms of a single measure of probability whether the scatter of points in the control chart is more than might be expected through chance fluctuations were the data homogeneous.

(1) *Control Test for Means.*

Derived by R. A. Fisher.* Using the notation introduced on p. 50 above, and supposing that the k samples are not necessarily of equal size, we may write

$$\bar{x}_0 = \frac{1}{N} \sum_{t=1}^k \sum_{i=1}^{n_t} (x_{it}) = \frac{1}{N} \sum_{t=1}^k (n_t \bar{x}_t) \quad . \quad . \quad (16)$$

$$\sum_{t=1}^k \sum_{i=1}^{n_t} (x_{it} - \bar{x}_0)^2 = \sum_{t=1}^k n_t (\bar{x}_t - \bar{x}_0)^2 + \sum_{t=1}^k \sum_{i=1}^{n_t} (x_{it} - \bar{x}_t)^2 \quad (17)$$

$$\text{or} \quad N s_0^2 = \sum_{t=1}^k n_t (\bar{x}_t - \bar{x}_0)^2 + \sum_{t=1}^k (n_t s_t^2) \quad . \quad . \quad (18)$$

where \bar{x}_0 is the mean and s_0 the standard deviation of the N observations pooled together. There are now two methods of carrying out the test which are equivalent, but are derived from somewhat different lines of approach and involve the use of different probability tables.

(i) a. *Following R. A. Fisher's "Analysis of Variance" Technique.*†

Form the following table, based on equation (17), dividing the total variation into two parts.

	<i>Sum of squares.</i>	<i>Degrees of freedom.</i>
From variation of means	$\sum_{t=1}^k n_t (\bar{x}_t - \bar{x}_0)^2$	$k - 1$
From variation about means	$\sum_{t=1}^k \sum_{i=1}^{n_t} (x_{it} - \bar{x}_t)^2$	$N - k$
TOTAL	$\sum_{t=1}^k \sum_{i=1}^{n_t} (x_{it} - \bar{x}_0)^2$	$N - 1$

* See *Statistical Methods for Research Workers*, Chapter VIII. and *Journal of Royal Statistical Society*, LXXXV, 1922, p. 605. † *Ibid.*

Then if the hypothesis of control is true, the sample means differ only through chance fluctuations, and

$$k-1 \sum_{i=1}^k n_i (\bar{x}_i - \bar{x}_0)^2 \quad \text{and} \quad \frac{1}{N-k} \sum_{i=1}^k \sum_{j=1}^{n_i} (x_{ij} - \bar{x}_i)^2 \quad (19)$$

will be two independent estimates of the unknown variance, or squared standard deviation, σ^2 .

The hypothesis is tested by examining the significance of z , which is half the *natural logarithm* of the ratio of these two estimates. Tables of the 5 per cent. and 1 per cent. probability levels of z are given by Fisher in his book.

(i) b. *Using the Squared Correlation Ratio, η^2 , as Criterion.*

$$\eta^2 = \frac{1}{N} \sum_{i=1}^k \{n_i(\bar{x}_i - \bar{x}_0)\}^2 / s_0^2 \quad . \quad . \quad . \quad (20)$$

As η^2 increases from 0 towards 1, the hypothesis of control becomes less and less likely. The sampling distribution of η^2 , were the hypothesis true, is given by,

$$f(\eta^2) = \text{constant} \times (\eta^2)^{\frac{1}{2}(k-3)} (1 - \eta^2)^{\frac{1}{2}(N-k-2)} \quad . \quad (21)$$

for which the probability integral for a certain range of values of N and k will be obtainable from the *Tables of the Incomplete Beta Function*,* or by any other method used for dealing with this distribution.

The first method may be used on the data of illustration (2), section (4), taking the 100 observations broken up into 50 groups of 2. The analysis of variance table is as follows:—

Variance.	Sum of squares	Degrees of freedom.	Estimate of σ^2 .	$\frac{1}{2} \log_e(\text{estimate})$.
Between samples ..	563.00	49	11.490	1.2207
Within samples ...	359.94	50	7.199	0.9870
Total	922.94	99	Difference = $z = 0.2337$	

To judge whether z is significant, we may either interpolate in Fisher's tables with $n_1 = 49$ and $n_2 = 50$ degrees of freedom, or make use of the fact that when n_1 and n_2 are large and nearly equal, z is approximately normally distributed with a standard error of

$$\sigma_z = \sqrt{\frac{1}{2} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)} \quad . \quad . \quad . \quad . \quad (22)$$

In the present case, $z/\sigma_z = (0.2337)/(0.1421) = 1.64$, and the tables of the normal probability integral show that this value would

* To be issued shortly by *Biometrika*.

be exceeded by chance in about 1 case in 20. The fluctuations in mean ash-content found from consecutive samples of 2 increments would therefore be judged as barely of significance, were it not for the systematic nature of these fluctuations referred to above and seen in Fig. 4.

The second method (i. b) may be used on illustration (1), section (4), (Lamp data). Here,

$$N = 75, k = 15, n_i = \text{constant} = 5, \gamma^2 = 0.3449,$$

and it may be found from (21) that the chance of obtaining as large or a larger value of γ^2 were the hypothesis of control true, is given by $P = 0.015$. That is to say, the scatter of the means is rather exceptional.

The expression (21) for the sampling distribution of γ^2 is derived on the assumption that the quality, x , is normally distributed, but this test is not at all sensitive to changes in the form of the distribution law.* In fact, it may, I think, be safely used if the $(\sqrt{\beta_1}, \beta_2)$ point falls within the circle defined above and shown in Fig. 8.

(ii) *Control Test for Standard Deviations.*

The use of the following criterion, L , has been suggested by J. Neyman and the present writer, to test the hypothesis that the k variances $s_i^2 (i = 1, 2 \dots k)$ do not differ significantly.†

$$L = \frac{\sqrt{\frac{N}{k} \prod_{i=1}^k (s_i^2)^{n_i}}}{\frac{1}{N} \sum_{i=1}^k \{n_i s_i^2\}} \quad \dots \quad (23)$$

L is therefore the ratio of the weighted geometric to the weighted arithmetic mean of the group variances, and is independent of the unknown σ . The hypothesis of control becomes less and less likely as L tends to zero. If the variation in x be normal, the moments of the sampling distribution of L (if the hypothesis of control be true) have been found, and an approximation to the probability integral, again depending on the Incomplete Beta Function, has been suggested.‡

In the case of the 15 samples of 5 lamps (illustration (1), section (4)), it is found that $L = 0.9138$, and the approximative method shows that the chance of obtaining a value of L as large or larger

* A paper discussing this question was published in *Biometrika*, XXIII, pp. 114–133.

† “On the Problem of k Samples.” *Bulletin de l'Académie Polonaise des Sciences et des Lettres*, Série A, 1931, pp. 460–481. See also *Biometrika*, XXIV, p. 415.

‡ See papers referred to in the preceding footnote.

than this, if the variances are controlled, is 0.015. In act, as is suggested by the chart, the 15 values of s_i^2 are unusually close together. As we have seen, there is evidence of some lack of control from sample to sample in the mean length of life, but this is not so at all for the standard deviation.

The sensitiveness of this criterion, L , to changes from the normal in the distribution law of x is under investigation.

(iii) and (iv). *The Coefficient of Variation and the Range.*

No exact single control tests exist in these cases to measure the significance of the scatter shown in the charts.

(v) *Control Test for Co-variation.*

The possible applications of theoretical methods of analysis of co-variation have hardly yet been fully explored, but it is already clear that a number of important problems of this nature exist in the industrial field. One of these has been referred to above in section (4), dealing with control of the correlation between tensile strength and hardness.

There is little doubt that use can be made of :

(1) R. A. Fisher's method of Analysis of Co-variance (see the recently published 4th Edition of *Statistical Methods for Research Workers*).

(2) Certain novel generalized criteria recently suggested by Dr. S. S. Wilks, a National Research Fellow of Columbia University (*Biometrika*, XXIV, pp. 471-494).

(vi) *Control Test for Fraction Defective.*

If b_i be the number of units bearing a character A , in a sample of n_i ($i = 1, 2 \dots k$) R. A. Fisher has pointed out that the test of homogeneity is a χ^2 test.* We should take, in fact,

$$\chi^2 = \sum_{i=1}^k \frac{(b_i - \frac{pn_i}{1-p})^2}{n_i p(1-p)} \dots \dots \dots (24)$$

The number of degrees of freedom, f , with which to enter the tables of the χ^2 probability integral should, I think, depend upon the type of problem.

Problems of type (1); p based on some previous standard, $f = k$.

Problems of type (2); p_i estimated from data, $f = k - 1$.

The theory is based on the assumption that the expected frequencies pn_i are not too small, a condition $pn_i \geq 5$ being often adopted. When dealing with the fraction of defective units, p may, however,

* *Statistical Methods for Research Workers*, sections (20) and (21).

be of the order of 0.01, and the question of whether the test may be used when pn_i has values of about 1 or 2, needs rather careful consideration. Some experimental evidence seems to suggest that the standard theory still provides a good approximation to the distribution of χ^2 even in such cases as these. The problem is certainly one calling for research.

TABLE VIII.
Multipliers for Calculation of Control Limits.

n.		Limits.				Central Measures.	
		0.001.	0.025.	0.975.	0.999.	B_m .	C_{red} .
2	A	2.185	1.386	1.386	2.185	0.5642	
	B	0.001	0.022	1.585	2.327		
	C						
3	A	1.784	1.132	1.132	1.784	0.7236	
	B	0.026	0.130	1.568	2.146		
	C						
4	A	1.545	0.980	0.980	1.545	0.7979	
	B	0.078	0.232	1.529	2.017		
	C						
5	A	1.382	0.876	0.876	1.382	0.8407	1.489
	B	0.135	0.311	1.493	1.922		
	C	55.07	10.32	0.4487	0.2708		
6	A	1.262	0.800	0.800	1.262	0.8686	1.379
	B	0.187	0.372	1.462	1.849		
	C	28.54	7.218	0.4676	0.2925		
7	A	1.168	0.741	0.741	1.168	0.8882	1.309
	B	0.233	0.420	1.437	1.791		
	C	18.37	5.657	0.4845	0.3117		
8	A	1.092	0.693	0.693	1.092	0.9027	1.261
	B	0.274	0.460	1.415	1.744		
	C	13.37	4.734	0.4996	0.3289		
9	A	1.030	0.653	0.653	1.030	0.9139	1.225
	B	0.309	0.492	1.396	1.704		
	C	10.50	4.129	0.5133	0.3445		
10	A	0.977	0.620	0.620	0.977	0.9227	1.199
	B	0.339	0.520	1.379	1.670		
	C	8.681	3.703	0.5257	0.3587		

In the case of illustration (4), section (4), we find $p_i n_i = \text{constant} = 4.25$, and using equation (24),

$$\chi^2 = 18.13, f = k - 1 = 11.$$

Assuming that we are justified in using the method in this case,

the χ^2 tables show $P = 0.079$, and this is not an exceptional result for controlled variation.

It must, however, be emphasized that a longer series of records is desirable if any useful conclusion is to be drawn from this test. It may, then, be possible to divide the records into a number of rational sub-groups, so that the test for control of fraction defective becomes a test for control of the χ^2 defined by (24).

DISCUSSION ON DR. PEARSON'S PAPER

SIR RICHARD REDMAYNE: I have read this paper with great interest and with very much benefit. I feel quite unqualified to say anything on the subject from the point of view of manufactured articles, because the only articles with the manufacture of which I am concerned are steel and hemp ropes, but in regard to these I can thoroughly bear out what Dr. Pearson says in one part of his paper, with regard to the allowance of a big factor of safety and a large margin between that and working stress. That is perfectly true of wire ropes, and I thoroughly agree with him that if a closer system of testing and maintenance of charts—in fact, statistical control—were devised, it would be a great benefit not only to the rope-makers, but to the mining and other industries which use the ropes.

When he comes to deal with the subject of coal I feel a little more at home, having been engaged for about fifty years in coal-mining. More and more the purchase of coal—which after all is our main asset in this country—is being carried out on an analytical basis, so that more and more it is necessary to exercise some form of statistical control by the maintenance of a regular system of analysis at the colliery, and I would like to say here that forty-six years ago I introduced the first laboratory at a colliery in this country. It was then rather a revolutionary procedure, but now every large colliery company has its own system of laboratory working on a system of almost daily analyses, and the maintenance of charts. The cost of this work is a mere figment compared to the beneficial results obtained. For instance, it is only by these means that one can ascertain whether coal washers are being properly worked.

I would like to draw attention, in no spirit of destructive criticism, to the example (c) as to the ash-content of coal. You will see that the ash-content in the coal varies from 9.5 up to 25.5. True, Dr. Pearson says that it is a rough slack, and although the inherent ash in the coal may be only 3 or 4 per cent., the ash-content can be very high indeed by reason of the adventitious dirt mixed with the coal. In times of prosperity this is much higher than in times of adversity, because coal is easy to sell in times of prosperity and less care is exercised in keeping it clean. During and immediately after the War, when the price of coal was high, the complaints of the gas companies were loud and long because of the great increase in adventitious ash.

In the example given by Dr. Pearson the percentage shown over this range of five years is unduly high, and I can only think that in that case the coal must have been derived from a number of different sources. I take it as the essence of any scheme of statistical control that the basis on which that is built should be the same—that is to say, in the case given by the author it should not only have been coal from the same colliery, but from the same seam, because both inherent and adventitious ash vary considerably as between seams.

Not a very great deal of rough slack is now disposed of. More and more washed coal is demanded on the part of the consumers. Dr. Pearson may take it from me that homogeneity of product is much closer than it was. During the period of a year the ash in a washed slack from a given seam would not vary by more than half a percentage. That does not detract from the importance of statistical control, which is necessary to secure the efficiency of the working not only of the washing machines, but of the coke works also, in order to know to a nicety what is the daily variation of the product which is being disposed of.

I think this is true to a lesser degree also in the case of iron ore, but with regard to the raw product with which I am chiefly concerned—namely, coal—I thoroughly endorse the views that Dr. Pearson has so ably expressed to-night, and I have the greatest possible pleasure in proposing a hearty vote of thanks to him.

DR. WISHART: It gives me very great pleasure to second the vote of thanks to Dr. Pearson for his interesting and valuable paper. It is indeed fitting that the Galton Laboratory of the University of London, whence so much in the way of original statistical work has gone out to the world through the untiring labours of Professor Karl Pearson, should now be the source, through his son, of a paper which will direct the attention of business men to a most important application of familiar statistical methods in the control of manufactured products.

Dr. Pearson finds much of his inspiration in a recent book of Dr. Shewhart, of the Bell Telephone Company of New York. I have not had an opportunity of seeing this book, but the very lucid description given by Dr. Pearson, most of which should be comprehensible by even the least mathematically minded of his audience, shows that the value of Dr. Shewhart's work lies not in inventing new statistical tools for use in this important subject of quality control, but rather in directing the attention of the statistical departments of business concerns to the tools that have already been forged, many of them in that very workshop from which the present paper comes. Nor, I imagine, is the British Standards Institution the first in the field in promoting the recognition of such methods in the industrial field. *Vixere fortes ante Agamemnona multi*—I am far from suggesting that the rest of the quotation is apposite in the present case—and I am quite sure that British industry has for a long time in the past had in many instances its statistical departments, equipped with men of considerable intellectual ability, and methods very like those dealt with in detail in the paper before us must have been used for many

years. It is all to the good, however, that the attention of industrialists should be directed publicly from time to time to what is possible, if only that the average level of performance in this respect should be improved. Dr. Shewhart and the Committee of the British Standards Institution, including our speaker of to-day, will have done valuable work if they succeed in persuading industrial firms in any considerable number to standardize their statistical methods, as well as the quality or the product they set out to control. Only so will it be possible for the smaller concern, lacking the resources of the great companies, to follow the lead of the latter in the application of the methods. The question of whether it will pay them to do so can safely, I think, be left to the firms themselves, when they have had a little experience.

I am particularly interested in the theoretical bases of the methods under discussion. Here Dr. Pearson has taken care to be as up-to-date as possible, as one can see from references to papers published for the first time only a few weeks ago. In many instances he has overtaken the theoretical statistician, and has indicated points of theory that will require further elucidation. We may be sure that he will not rest content with a mere statement of such problems, but will go on with their study. But in the main the method rests on a progressive examination of means, standard deviations, and coefficients of variation in a series of small samples of the product under examination, and the pictorial representation of the variation of the material by means of controlled charts. I am very glad he has replaced Dr. Shewhart's somewhat arbitrary limits of multiples of the standard deviation by limits based on a knowledge of the random sampling distribution of the particular statistic dealt with. This is the sound method, whose limitation is that the treatment is only appropriate when the true population values are not known, but have to be estimated from the data. On this question of estimation, and in connection with the calculations leading to the drawing of control charts, Dr. Pearson has indicated that there is room for a difference of opinion as to whether in calculating the sample standard deviation one should divide by n_i or $n_i - 1$. I must confess to a preference for the latter; not that there is any real error, as he says, but I prefer the zero line of the control chart to measure as well as estimate the true variability of the population, and not the biased estimate obtained from what are in many cases exceedingly small samples.

The question of the representativeness of the samples has been touched on, but only lightly. I should incline to regard this as just as important a point as the subsequent testing for control. Usually, the size of sample taken at a particular time, or from a particular machine, will be quite inadequate to furnish an accurate estimate of the parameters of the entire population of articles. There is all the more reason, then, for ensuring that the sample shall be as representative as possible of the consignment. In addition, some estimate of the error of such sampling would be of value. A study of sampling technique, which has proved fruitful in other fields of enquiry, may well repay the time and labour given to it. To give one simple illustration, it may well be that in looking for time changes in a manu-

factured product we ought to have at least two independent samples taken at each time interval, and not one.

I will not take up your time further on theoretical points, but will just say this, that the working out of some of the tests, based as they are on recent developments in theory, will be watched with interest by statisticians. It is possible that some of them may err on the side of over-elaborateness. For example, Dr. Fisher's analysis of variance technique is simple, and is designed to test whether a group of samples might reasonably have come from some homogeneous population. If a positive answer is given to the test it is usually possible to see without much trouble whether it is due to a difference in means or in standard deviations. But it should be pointed out that the test may lead to a negative result, where on further examination heterogeneity of material is shown to exist. I believe that the application of the analysis of variates method, aided by certain relatively simple supplementary tests, will do all that is necessary or desirable in the way of disentangling the relationships of the data. In any case I am afraid it may be difficult to persuade those who are unaware of the usefulness of statistical method to take up work of this kind. Our only hope, then, is to keep the calculations as simple as possible, and I am not sure that most of the information that the data are capable of furnishing will not readily be yielded by such simple tests.

MR. WILSDON said that, as a visitor, he would like to express his appreciation of the paper to which he had just listened, with the very clear statement of the problems given by Dr. Pearson, and also of the opportunity afforded to take part in the discussion. He felt that he was speaking for many besides himself when he said that the opportunities for discussion of such problems were too few and far between. There might be, as had been stated by Dr. Wishart, a large number of highly qualified statisticians now working for industrial concerns, but it was very seldom that an opportunity occurred when problems of common interest, such as had formed the subject-matter of Dr. Pearson's paper, could be discussed together.

As an amateur statistician it had always appeared to him that the particular branch under discussion, that of small sampling, was not sufficiently differentiated from statistics as a whole. There appeared now to be no reason why the average scientific worker should continue to think that no advances had been made since the days of Gauss. Dr. Fisher's work had been a Bible for many scientific workers in applying statistical methods. Dr. Shewhart, he felt, would be considered to have done a similar service for the manufacturer and the process manager. It was a great pleasure to welcome a statistician of the standing of Dr. Pearson to the wide and largely unexplored field of statistical control in problems of standardization and specification.

Perhaps a little more could be said to reinforce the demand made by Dr. Pearson for a closer specification of the quality of manufactured articles. In a pregnant phrase he had stated that in the application of statistics the main object would be to provide a scientific

basis for the establishment of economic standards of quality. Mr. Wilsdon proposed to underline the word "economic" for the moment. An economic standard was presumably one that was determined by that level of manufacturing control which would provide an economic margin of profit between costs of production and selling. In that standard only the manufacturer appeared to play a part. The user should, however, be taken into account in estimating what was an economic standard, because once an efficient method of specifying the quality of the material had been provided, there was created a means whereby markets might be influenced. An economic standard could, therefore, only be considered as defined when quality was capable of specification in a manner which allowed its reactions on marketing factors to be taken into account.

In many branches of commerce there was a need for closer specification of the quality of the materials, and this was only possible when the product was controlled. It should be possible, therefore, to look forward to a more scientific employment of statistical criteria in departments usually relegated to the sales manager or advertising expert—where the cold light of science only too infrequently played a part.

Dr. Pearson had in his address discussed only what might be called "spot" specifications; by this term one might distinguish such specifications as afforded merely terms of a contract between a supplier and purchaser for a limited supply of material. He had shown how in such specifications there was a "nominal" level determined by the clause, but that, in addition, there were two other levels determined by the variability of the product sampled, and the sampling technique. These levels defined, on the one hand, a limiting region within which the manufacturer must control his products in order that he should run only a small risk of his material being rejected. Such a level might be called the "producer's safety level." On the other hand, the consumer must consider another level, different from that represented by the nominal specification, if he wished to reduce to a required small risk the chance of accepting material, on the basis of samples, which was below the standard quality. The efficiency of a specification was roughly proportional to the narrowness of the belts defined by these levels. It must be admitted that, regarded in this light, there were few specifications that could bear examination.

However, specification, even if statistically inefficient, had done a great deal in this country to help the small manufacturer. The mere fact that a product was *liable* to be tested afforded a salutary incentive to raising the standard of a product. As an example, mention might be made of a series of materials which were of great importance to the builder, such as limes, cements, etc. The importance of efficient specification lay in the fact that the craftsman depended upon the uniformity of his material to develop his technique. Under present conditions—and modern commercial evolution tended to increase the difficulties—a material bought under a given name was not necessarily the same in one place as it was in another, or the same in two deliveries. This might give rise to very serious trouble, as

when plasters of two different natures were sold as the same brand. A "spot" specification, necessarily designed to control only minimum requirements and applicable to all the various brands of plaster, might, however, be quite ineffective, without impossible elaboration, in distinguishing changes in quality which would seriously affect the craftsman. The only way out of dangers of this sort would appear to be in the development of what might be called a Mark system, such as was found in the administration of the National Mark by the Ministry of Agriculture. It was not commonly recognized that that system was not confined to mere questions of the grading of a product, but actually controlled quality by quantitative criteria. The underlying theory must recognize that any method of control by a mark must be based on some statistical estimate of the manufacturing control of the product. In this direction it was possible to see a wide application of the principles outlined by Dr. Pearson.

Mr. Wilsdon said that he had spoken largely of the ideals underlying the application of statistics in problems of specification; they were, however, of practical importance in the prosperity of the nation, which now depended upon gaining markets, if not on maintaining them. Both the manufacturer and the consumer, however, had to be educated, and by discussions of this nature a fruitful step was taken in aiding that education.

MR. CONNOR said he wished to pay a very hearty tribute to Dr. Pearson's work on this new and difficult subject. Those who had the privilege of association with him on the British Standards Institution Committee on statistics would appreciate his patience, judgment, general competence, and readiness to consider any kind of suggestion. The idea of applying statistical methods to quality control was old, but until lately it had remained purely academic. The first man to indicate how this idea might be put upon a commercial basis was Dr. Shewhart, of the Bell Telephone Company, New York, and his book on the *Economic Control of the Quality of the Manufactured Product* was the standard work on the subject. Dr. Pearson brought to bear not only a high degree of personal skill and judgment, but also the accumulated learning of the British school of statisticians, which could challenge comparison anywhere. He was no mere expositor, but had made improvements in the original technique advocated by Dr. Shewhart. Mr. Connor said that the main points he wished to stress were Dr. Pearson's treatment of control limits for the standard deviation of the sample, and his approach to a technique based upon the range of the sample. It was clear that the industrialist would try to avoid the labour of calculation as far as possible. There would be a persistent demand for methods capable of quick calculation and simple application, and the suggestions made by Dr. Pearson, although not fully worked out, seemed capable of valuable extension in this field.

For those who had not had time to follow up the modern theory of the small sample, Mr. Connor explained that the mathematical basis of the theory was sound, in the sense that it depended upon perfectly reasonable assumptions as to the laws of combinations of

elementary probabilities, and that substantially the same results had been reached by investigators working along very different lines. At the same time, there was room for doubt as to some of the approximations used in order to make these problems manageable, and some authorities were inclined to question the validity of conclusions which depended upon excursions into n -dimensioned hyperspace. From that point of view the mathematical basis appeared to be sound, but one could not feel entirely sure.

In the last resort these tests must be empirical, because a decision had to be made at some stage of the process as to the probability level to be accepted as the basis of the control limits, and the acceptance of this or that probability level must necessarily involve an arbitrary act of judgment.

There was need for a further definition of the word "control" as used by Shewhart and his school. It did not mean "control" in the ordinary sense of the word, and an attempt should be made to distinguish between *manufacturing* control and *statistical* control. Manufacturing control existed when everything in reason had been done by the manufacturer to eliminate assignable causes of variation. On the other hand, statistical control existed when the variability in quality of the output could reasonably be ascribed to the combination of chance causes. These two things were not co-extensive, and progress would lie along the direction in which they could be assimilated.

DR. DUDDING said he would like to associate with Dr. Wilsdon in claiming himself to be an amateur statistician; he was certainly one of those who felt they had gained enormously by the setting up of a Committee by the British Standards Institution which had brought him in contact with Dr. Pearson and Dr. Snow of the Royal Statistical Society. Dr. Pearson had pointed out that a lot of common sense and judgment was wanted. In all these problems not only were there many pitfalls for the engineer who tried to use statistics, but an equally large number of pitfalls for the pure statistician who plunged himself into a factory and thought he could put the manufacturer right even inside of a period of ten years.

As regards specifications, as far back as 1925 a specification for lamps contained what might be classed under Dr. Pearson's title a "second-best method" of trying to get this idea into the specification, and although standard deviation did not appear in that specification, it did appear by inference by allowing 5 per cent. to fall outside certain limits. That specification, however, suffered from the drawback emphasized in a remark of Mr. Wilsdon, that it contained no statement as to safety level guaranteed to the user. There was a safety level for the manufacturer, but no indication of the chance that a user might purchase lamps which passed the tests but were actually a good selection from poor lamps.

With regard to the question of the control of lamp quality, the figures quoted by Dr. Pearson were chosen from data four or five years old because they illustrated one point to which he wished to draw attention, and it was no criterion of what the public would

now get from the same manufacturer. It was of interest that the application of this sort of statistical work for seven years had reduced the percentage failures of lamps, before 500 hours, very appreciably. The percentage was now less than one per cent. The large number of possible variables which could influence the life of lamps made its manufacture a particularly suitable subject for the application of statistics. In the manufacture of lamps first the tungsten had to be prepared and worked into wire; then one wire had to be coiled round another wire about the same size as itself. This was followed by various other lamp assembly processes, and no progress could have been made in determining the influence of various variables if the lamp engineer had not been guided by even second-best methods based formally on statistical annotation.

With regard to specifications, one of the biggest difficulties really lay in getting widespread the ideas contained in Dr. Pearson's paper so that the user would try to make himself familiar with the annotation of the statistician, and so provide himself with the means by which he would be able to appreciate a specification drawn in his own interest.

DR. IRWIN said he would like to refer to a method of statistical inference which had not been used by Dr. Pearson, but which might be of use in problems of this kind. (He might be slightly more technical in a statistical sense, but he hoped to be brief.) If one placed oneself in the position of a manufacturer of telephone receivers who was about to deliver a large consignment of these receivers and wished to give a guarantee that the variability of their sensitivity would not exceed a certain amount, how would one decide what value of the variability to insert into the guarantee? One might suppose one was in a position to test, say, fifty receivers, and it might perhaps be assumed that it would be sufficiently accurate to suppose that sensitivity was normally distributed. That being so, one would be in a position to specify the sampling distribution of variability in samples fifty. The point was that the value of the variability inserted in the guarantee should be such that if it were the true value, the observed variability would be the lower 1 per cent. point of the sampling distribution. The reason was that obviously the observed variability would be less than the true 1 per cent. point once in a hundred times, and whenever the observed variability was less, the value inserted in the guarantee would be less than the true variability, and with the same frequency. Therefore the manufacturer would only be let down on his contract once in a hundred times.

Dr. Irwin said he brought this point up partly because it was of considerable interest in connection with the philosophy of statistical inference, partly because they had succeeded in making an inference about an unknown variability quite independent of any assumption about *a priori* probability.

DR. DUDGING thought there was a serious fault in the last speaker's assumption. It appeared all right from the manu-

facturer's point of view, but if on the other hand there was a definite change in the quality of a product, what would be the inference from the consumer's point of view? How often would the consumer take a 20 per cent. worse article because the test samples had come out above the quality level specified? This question could be answered, but that was the very point that it was hoped to get into these specifications, and it must always be borne in mind. The final answer would have to be determined largely empirically, because it must always be based on how big a change could be allowed in the product without detriment to the user. That was the most difficult thing to settle on a purely statistical basis; in industry one always got driven back finally to the use of a little common sense.

MR. DUDLEY W. WALTON said he entirely appreciated the extraordinary clarity with which Dr. Pearson described this method. Dr. Shewhart, who had done so much to develop the technique, was also a Fellow of the Society, and it might be hoped that some day he would himself continue the exposition of the subject.

There seemed to be a double technique involved in the method of statistical control—the technique of having presented to one a record of existing observations and trying to interpret the meaning of the variations of those observations, and that of determining what would be the probable future of variations if a system of statistical control were put in.

It would be useful to elucidate the method of sub-grouping. From listening to Dr. Shewhart it might be gathered that he shuffled the cards until the groups pleased him, but that was not really what happened. If there were twenty processes in a manufacturing operation, the first and second might be worth analysing, but the third, fourth and fifth might be so perfect that there was no need to worry about them, and to that extent there was a selection of groups to be analysed.

It was not necessary to work out elaborate mathematical formulæ; ordinary workshop practice would suffice for determining the limits. The point made by Dr. Shewhart was that having examined one of the groups and having analysed out the system of classes and effected an improvement in a process, a start was made from that point to work out new limits. It was not necessary to begin with an elaborate determination of limits. There were ways of short-circuiting the calculations.

MR. PROVEN said he would like to draw attention to an obvious point already hinted at by previous speakers. This was that in certain cases it was not a question of the chance of a thing being right; it was necessary to be dead certain. The cases to be considered could be divided into two types. This control could be applied to such things as telephones and electric lamps, but in other things, where human life was involved, there must be dead certainty.

This led up to the question of engineering factors of safety, and these would have to remain, however much statistical control was developed, because of the one chance of danger in a million.

MR. CRUMP desired to join in this vote of thanks for what was one of the most interesting and valuable papers he had heard at the meetings of the Society. He did not propose to go into the mathematical details of the paper, but wished to address himself firstly to the final paragraph in which Dr. Pearson indicated that his contribution might seem to be of small account in the present impasse affecting the whole world system of exchange and supply. He would like to say that this idea was totally wrong, because any technique calculated to reduce the cost of production and add to the efficiency and quality of what was produced was of the highest possible economic importance at the present time. Another point in the paper opened up rather a new field, and brought to mind the whole matter of checking, which applied to every sphere of human activity. There was always the liability to human error, and to counteract this, elaborate checks had everywhere been evolved. In fact the question arose whether most of us were not guilty of waste effort in the form of unnecessary checking. For example, an appreciable number of people were employed in banks and financial houses in the perfectly deadly work of checking ledger entries and totals. In his own profession of journalism, a substantial amount of time was spent in checking first copy and then proofs, so much so that in the end the reader found he knew the text he was checking by heart, so that mistakes were passed by unnoticed. Such checking, he realized, was absolutely essential, but he often wondered whether any attempt had been made to see how often errors were so detected, and what relation the number of detected errors bore to the work involved. Dr. Pearson had at last brought to notice a technique which provided the means for such an investigation, and he (the speaker) would like to see if it could be adapted and applied to such fields as those referred to. In any case, he was very glad to lend his support to the vote of thanks.

DR. SNOW said that as the Honorary Officer of the Society chiefly responsible for getting Dr. Pearson to read his paper, he was particularly pleased to have the opportunity of expressing his thanks to Dr. Pearson and his appreciation of the paper. As Dr. Pearson had said, the application to practical affairs of the statistical methods which had been largely developed at University College under the guidance of his father, Professor Karl Pearson, had grown much faster in the United States than over here. The American Statistical Society had been the means of assisting discussion on the many problems to which these methods applied, and it seemed that the time had now arrived for some organization to take the initiative in providing similar facilities on this side, and he (Dr. Snow) hoped that the Royal Statistical Society might, now that it was approaching its one hundredth birthday, consider some extension of its scope by which it could provide the platform for discussion on the practical every-day application of statistical methods applied to sampling. In order to give some idea of the scope of these practical problems in this country he proposed to go somewhat outside Dr. Pearson's subject-matter in his remarks. Dr. Pearson was dealing almost

entirely with the application of the theory of sampling to the control and standardization of the quality of manufactured products, but his paper, wide though it was in its choice of illustrations, only touched on one side of the every-day application of sampling. There were many questions of sampling involved in the problems associated with the raw materials of industry, and he proposed to give one or two examples of these. Some millions of tons of raw materials and food-stuffs were imported into this country every year, and in a very large proportion of those imports samples had to be taken on arrival, purporting to represent the bulk. He had read about one hundred of the contracts used in the purchase and sale of these materials, probably not a large proportion of the total in use. Many of these contracts contained a so-called "sampling clause." In many cases these clauses merely set out that a sample should be drawn by some independent person "in sufficient quantity to correctly represent the bulk." The result could readily be imagined by those with experience in the subject of sampling. In the case, for example, of a consignment of, say, 200 tons of tanning materials containing 2,000 or 3,000 bales, the independent person, generally the master-porter at the docks, split a few bales conveniently situated, took out a few handfuls and made a heap. This was divided into four parts, of which two were sealed in case arbitration was subsequently called for. The other two were left open, one in the possession of the seller's representative and the other with the buyer's representative. When the buyer received the bulk delivery, if, as frequently happened, it was not up to his expectations, he drew another sample of it and sent it to his representative at the port. This representative compared it with the open sample in his possession, and quite frequently without any scientific analysis at once decided that the samples were substantially different. If the buyer's discontent was great enough to cause him to go to arbitration, the arbitrators then formed their judgment only on the sealed sample, which might be different from the others, and without any attempt being made on their part to decide whether or not it was a satisfactory representation of the bulk. The mathematicians present would appreciate the extent to which the element of luck entered into the business, but on the whole, although it was completely lacking in any scientific foundation, it gave rough-and-ready justice and enabled the wheels of industry to continue to turn. In some cases, however, some attempt at precision was made in the sampling clause of the contract. In the case of cotton-seed cake, for example, the contract provided that samples were to be drawn and sealed in four portions. One sealed sample was to be submitted to the analyst of the Cattle Food Trade Association. If, when the result of this analysis was announced, either the buyer or the seller was dissatisfied, the second sealed sample was submitted to a certain analyst. If the result of this analysis came within $\frac{1}{2}$ per cent. of the first one, the mean of the two results was to be accepted for the settlement of the bargain. But if the variation exceeded $\frac{1}{2}$ per cent. either of the parties to the deal might call for a third sealed sample to be sent to another analyst, and the contract provided that out of these three analyses the mean

of the two which were closest to one another should be accepted as final and binding on both parties. This somewhat complicated formula suggested an interesting problem to put before mathematicians who were still in practice, which might be enunciated as follows:—Three samples are drawn at random from a distribution and some attribute measured. What is the chance that the average of the two samples which are nearest together shall be nearer the true mean of the distribution than the average of all three of them? That illustration would show the mathematicians that there were problems in theoretical statistics awaiting solution just as much in Mincing Lane as in the laboratories of manufacturers' research associations.

When they proceeded to the next stage and considered the semi-manufactured products which were the raw materials of the articles discussed in Dr. Pearson's illustrations, the problems of sampling still persisted. They could be illustrated in the case of leather. A piece of sole leather as produced measured about 4 feet 6 inches by 2 feet 6 inches, and it varied substantially in composition from point to point in the same piece, and the composition at one particular point in one piece differed from the composition at the corresponding point in another piece. Sampling, accordingly, became a matter of importance, and an international society of chemists with no knowledge of the mathematical theory of sampling fixed upon a point in the interior of the piece of leather which they considered gave a reasonable average for the whole. But this was in practice an inconvenient spot, as a sample taken from it depreciated the value of the whole piece, and accordingly it not infrequently happened that the sample was taken from an edge, by which the value of the whole was not depreciated. Sampling of leather was now becoming a question even of diplomatic importance, as one European Government had stipulated that imported sole leather must satisfy a certain specification. It was a specification not difficult to satisfy if the sample were taken at the average spot, but the Government in question had decreed that the sample should be taken at another place, and it was impossible for most of the leather made in the world to satisfy the specification when sampled at this spot, and the result had been that import had been cut down to practically nothing. A specification for imported material might be a much more effective means of restricting imports than any system of import tariffs which could be devised.

Because of the very wide scope of the application of the mathematical theory of sampling to business problems he thought that Dr. Pearson's paper, showing how these problems could be tackled, was one of the most important the Society had had for a long time. Many business men might be appalled at the mathematical appendix to the paper, but he could assure them that these elegant mathematical theorems were only the scaffolding by which the tables were built up and by which the chances referred to by Dr. Pearson were read off. It was necessary to be able to read tables intelligently, but this did not entail attaining the skill involved in building up the scaffolding. He thought that the Society should now take on itself

the responsibility of spreading the gospel which had been so interestingly set out by Dr. Pearson, and he hoped that the Council would, at an early date, give consideration to the ways and means of doing so.

THE RT. HON. LORD MESTON said that in putting the vote of thanks to the meeting he would like to add his testimony to the extraordinary interest of the paper, and also to the interest of the discussion that had taken place. There was only one feature of that discussion that filled him with alarm, and that was the suggestion that in future one should be content with a somewhat less elaborate sampling and cross-checking of Bank balances! The abolition of the trust which most men so pathetically entertained with regard to the accuracy of their over-drafts was certainly an alarming proposition. Seriously, however, the paper and discussion had shown that the underlying theory of the subject impinged upon the most valuable practical results of every-day life. The Society was deeply indebted to Dr. Pearson for the paper he had read that evening. He had much pleasure in putting the motion to the Meeting.

The vote of thanks was carried unanimously.

The following contribution was received after the meeting from MR. A. B. BLAKE, B.Sc., A.M.I.Mech.E. :—

In industrial processes statistical methods can be applied to standards of performance of men and machines, as well as to those of the physical nature or exactness of the product. When the rate of production is set by machines, as in certain branches of the textile industry, it is important to establish the real optimum rate of output of a machine together with the operative, and to maintain it.

In the industries where the rate of production is set by the human factor, the determination of an optimum output can be made only by a series of time and motion studies, with or without the use of a constant-speed motion-picture camera using a 16 mm. width film. So far as I am aware, there has been no real statistical treatment of human effort as recorded by time and motion study, and any such analysis might conceivably go some way to remove the prejudice against piece-work, premium bonus and other methods of payment by results. It is interesting to note that Charles Babbage was a pioneer in the application of detailed time study in manufacturing processes.

These considerations cannot be followed up now, but the interesting paper presented by Dr. Pearson rather points to the extension of the methods illustrated therein to the control of exactness. In the technique of production this problem is known as Inspection, and it is basically a management problem with a commercial background. The development of Inspection in many of its aspects has followed, as a natural sequence, on the adoption of intensive and specialized methods of manufacture. The aim is the preservation

of uniformity of quality within economic limits which shall reconcile the conflicting demands for higher standards and lower production costs. In this connection it has been pointed out on many occasions, and recently with some force in Addendum II of the Report of the Committee on Finance and Industry, (Cmd. 3897) at page 212, by the Hon. R. H. Brand, C.M.G., and in Addendum III at page 234, by Professor T. E. Gregory, D.Sc., that what is required in industry, including distribution, is the reduction of cost *per unit of output*. This problem is fundamentally one for management. Inspection is one of the means of production control; it is the basis of quality control, and the real importance of this factor is only rarely appreciated.

If manufacturing industries are classified as Assembly Industries and Continuous Industries, then the problem of Inspection in the Continuous Industries, *e.g.* paper, textiles, chemicals, is one of the development of good quality in the final product where a defect means a "second" grade; *i.e.* a general problem of manufacturing Inspection. On the other hand, in the Assembly Industries Inspection includes attention to accuracy of manufacture and to interchangeability. In such cases, if statistical methods of control can answer the questions of (1) when to inspect, (2) how much inspection to give, and (3) how to inspect, so that the original conflict between rising standards of quality and a reduction in the cost of production can be reconciled, then a very serious problem is being removed from the sphere of trial and error.

Dr. Pearson refers to the desirability of allowing "a certain number of defective parts to slip through to a later stage in assembly." It must not be overlooked in this connection that the relative importance of overhead in the total cost of the product may be such that the increment at each stage of manufacture would suggest the elimination of defective parts as early as possible. The true function of Inspection is the prevention of scrap, and not merely the rejection of defective parts; and to this must be added the avoidance of loss at stages where accumulated cost is substantial and it is necessary to protect overhead previously earned. Thus in the manufacture of ball bearings it is essential to work with a permissible variation of 0.0005 in., and the product has to be handled without selective assembly. The parts are inspected at each operation both by a travelling inspection at the machines and a centralized inspection. Lastly, the components are given a final inspection prior to assembly when they are examined for dimensions, form, surface material defects, finish, hardness, and relative measurements.

DR. PEARSON replied: I do not think that there are many points which I need answer to-night. The main thing which I should like to do is to thank you very much for the friendly reception that you have given to this paper. What it contains is largely the result of co-operation; we have made a first step towards bringing together, in this field of application, the practical industrialist and the theoretical statistician. But there is very much

still to be done, and I know that until this contact is both closer and broader, expositions such as the one I have presented to you to-night may appear somewhat academic. When I read certain papers that have appeared in America, I feel that the subject is perhaps treated there more convincingly, not because any improved statistical technique is in use—indeed, the craftsmanship is largely from our English workshop—but because of the greater assurance obtained from a longer experience of practical application.

Dr. Pearson then answered a few points raised in the discussion, which he has since dealt with more fully in the following written reply :—

Sir Richard Redmayne's warm endorsement of the views of those of us who are working for the extension of methods of statistical control in industry is very welcome. Perhaps I may repeat two points that he has given from his own experience from which I think a moral could be drawn : that a research laboratory, at first considered revolutionary, has since been accepted as necessary by every large colliery; that the cost of such research analysis is nothing compared to the beneficial results obtained.

I am glad that Sir Richard has raised the question of variation in ash-content in coal. The data which I used were based on coal taken from the same seam of a single colliery. Washed slacks certainly have a lower standard error (as far as ash-content is concerned) than uncleaned dry slacks, but I am reliably informed that the ash variation in washed slacks is far greater than the $\frac{1}{2}$ per cent. mentioned. Can it be, perhaps, that we are speaking of differently defined measures? The variation in a sample of coal submitted to chemical analysis will depend upon the method of sampling. Each of the individual tests in the data discussed in my paper was representative of a single wagon, the whole of which was emptied and sampled. That the variation from wagon to wagon may be very large has been shown in a recent Report issued by the British Standards Institution.* "Average errors" of between 2 and 3 per cent. for slack are there referred to, which may be compared with my estimates of the standard deviation given on p. 38.

On the other hand, the tests on which Sir Richard Redmayne's figure is based may have been obtained by mixing samples from a number of wagons; a test result would then be in the nature of an average, and the variation from one test to another would naturally be reduced.

Dr. Wishart has made a number of valuable comments from the theoretical point of view, but I do not think that we disagree on any fundamental point. He has raised the question of division by n or $n - 1$ in calculating the standard deviation and of the apparent bias in the plotted control chart. I must admit that I have been somewhat puzzled myself as to the soundest course to follow. But I feel that the logical foundations of statistical theory are not yet

* *Report on the Sampling of Small Fuel up to 3 in.*, No. 403-1930, by Dr. E. S. Grumell and Dr. A. C. Dunningham. The measure of variation here used is the so-called average error or mean deviation, which for "normal" variation is about 0.80 times the standard deviation.

so firmly established that we can be confident of the practice which will ultimately appeal to statisticians as most reasonable, and have therefore suggested in this paper a course which, though it may not be final, is, I hope, consistent.

I am inclined to agree with Dr. Wishart that I have perhaps touched too lightly on the important problem of obtaining a representative sample from a consignment. But I hesitated to lay down any general rules for sampling, because it would seem that these can be formulated only in each special case, when it is clear what are the possible causes of variation in the production process, either in time or space. For this purpose information is required as to these possible causes and to the nature of the statistical control exercised by the average manufacturer. The technique of agricultural plot experimentation, for example, has been placed on a sound routine basis only after much investigation into the nature of causes of variation in fertility. In the industrial field such data have hitherto been difficult to acquire, owing to a natural reticence on the part of the manufacturer.

Dr. Irwin has raised an interesting point which is closely connected with a problem that arises in fixing testing rules in specification clauses. I think it is to some extent dealt with, though perhaps from a different approach, in my section (5).

I cannot quite agree with Mr. Proven that problems in which factors of safety are involved are distinct from others to which control methods may be applied. I think it is only a matter of degree. The many parts which make up a crane or the strands in a steel wire will vary in strength from unit to unit. The limits of variation in the strength of the whole can be determined accurately only after a study of the variation of the constituent parts. The maximum load may be placed at "mean breaking strength— $k \times \sigma$." Certainly k will not be taken as 3, but the value chosen will—or should—depend upon the magnitude of σ .

I do not think I need quarrel with Mr. Crump on the point in which he thinks that I am totally wrong. His suggestion of investigating whether the safety factor allowed for in checking ledger entries is excessive is one which might also be applied to computing, but I fear that, as for the cranes, k must be chosen rather large.

Finally, I would like to thank especially the four of my colleagues on the B.S.I. Committee who took part in the discussion, and pointed, in this direction and in that, to a wider field of application of these methods than I had attempted to survey.

As a result of the ballot taken during the meeting the following candidates were unanimously elected Fellows of the Society:

J. M. Atty, A.L.A.A.
Albert Reginald Bone, A.C.I.I.
Leon Frederic Duval.
Francis George Fleury.

Charles Arthur Hayward.
Douglas Patrick Thomas Jay.
John Stalker, O.B.E.
Leonard Henry Caleb Tippet.

MISCELLANEA.

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GRAUNT AND PETTY—A RE-STATEMENT.

By M. GREENWOOD, F.R.S.

FIVE years ago, in a review of the Marquis of Lansdowne's interesting volumes of *Petty Papers*,* I devoted a good deal of the space at my disposal to a critical examination of Lord Lansdowne's reasons for thinking that Petty was the author of Graunt's book. Lord Lansdowne's rejoinder to my comments, printed in his valuable edition of the correspondence between Petty and Southwell,† did not come to my notice at the time of publication and it was only the discussion in the Literary Supplement of *The Times* last autumn ‡ which made me acquainted with a most interesting book. It may be said that this question of authorship is of no more scientific importance than that of the *Junius* letters. But, since, in my opinion, the controversy reveals some failure to appreciate the essential significance of a classic, perhaps a few more pages may not improperly be devoted to the subject. I believe that no statistical book has been written which deserves more serious study by the tyro in medical statistics than that of Graunt; *not* because of its historical interest, great as that is, but because it enforces in the plainest language and using the simplest illustrations, lessons which must be learned by anybody who would avoid the pitfalls which beset the path of a medical statistician.

The discussion has ranged over various topics, one of primary, the other of secondary interest.

Of primary interest is the question whether the intellectual content of Graunt's book is so different from that of Petty's acknowledged writings that the hypothesis of a common author is untenable. Isaac Newton and Richard Bentley were contemporaries, they were

* *Journ. Roy. Stat. Soc.*, 1928, XCI, pp. 79-85.

† *The Petty-Southwell Correspondence*. Edited by the Marquis of Lansdowne, London, 1928, pp. xxiii-xxxii.

‡ Literary Supplement of *The Times*, Sept. 8, 1932, p. 624; Sept. 15, p. 643; Sept. 22, p. 666; Oct. 13, p. 734; Oct. 20, p. 761.

both men of transcendent ability, they were both fellows of Trinity College, Cambridge, and personally acquainted. No amount of secondary evidence, not even a note in Newton's handwriting that in 1695 he was interested in the Phalaris discussion, or one in Bentley's writing that before 1686 he was studying natural philosophy, would induce any human being to believe that Bentley was the mere amanuensis of Newton, or Newton of Bentley. They were utterly different people. Which was the greater is a frivolous question. Neither Graunt nor Petty comes within the class to which Bentley and Newton belong, but, as it seems to me, their intellectual contrast is as striking. In my review of his first publication I said that Lord Lansdowne's confession that he could perceive no difference between the style of Graunt and that of Petty was ingenuous. His rejoinder seems to me equally ingenuous. He says that my arguments "are all addressed to a comparison of *method* and not of *style*. For literary style, neither the *Observations* nor Petty's Writings are conspicuous, but I have yet to learn what differences can be detected between them in this respect." I have yet to learn why, when I am discussing the style of a statistical investigator, I should be reproved for not meaning something different. When one speaks of the style of a Bradman or a Jack Hobbs one usually means the style of their batting, not of their contributions to the newspapers.

Having delivered this blow in the air, Lord Lansdowne proceeds to address himself to this question of style or - if he thinks many words are better than one—method of using an instrument of research. He has summarized my arguments, not very accurately, into the three following propositions:

"(1) That the book (Graunt's book) opened up a 'field previously uncultivated' from which important results were obtained.

"(2) That the writer applied to this field a new 'critical method.'

"(3) That it contains the first 'London Life Table.'"

This is not an accurate summary of my argument for Graunt against Petty so far as (1) is concerned. I actually said that there were three reasons for the esteem in which Graunt's book was held and that the first, Lord Lansdowne's (1) "may also be said of Petty." So it was not necessary to tell me that it might be equally well said of Petty. Lord Lansdowne is, however, right in attributing to me the belief that (2) and (3) are decisive for Graunt. With regard to (2) I gave two examples of Graunt's sagacious criticism of the sources of statistical data, viz. his treatment of the statistics of the French Pox and of the contention that Rickets was a new disease.

On the first point, Lord Lansdowne asks whether it "may not

be seriously contended that the passage in question was more probably written by a Doctor of Physic of sixteen years' standing, who had made a special study of this disease, than by a London tradesman who was, so far as we know, totally unversed in medical matters?"

The answer is that it can be much less seriously contended than that the author of *Timon of Athens* was a specialist in venereal diseases. Timon's account of the clinical features of syphilis in the sixteenth century (Act IV. scene iii. lines 150-163) is a remarkable effort for a layman. Graunt exhibits no more knowledge of the ætiology and symptomatology of syphilis than he could have picked up in any coffee-house. He knew that the French Pox was "gotten, for the most part, not so much by the intemperate use of Vencry (which rather causeth the Gout) as of many common women." He knew that "by the ordinary discourse of the world it seems a great part of men have, at one time or another, had some species of this disease," and he wondered "why so few died of it, especially because I could not take that to be so harmless, whereof so many complained very fiercely." Perhaps an Oxford Doctor of Physic in the sixteenth century was not a very good syphilologist, but he knew a little more than that.

The second passage, on Rickets, Lord Lansdowne thinks goes far to support his contention. "The paragraph in question, with its nice distinctions between these allied diseases, could, like that mentioned above, scarcely have been written by a man unacquainted with medicine, but would have come easily to one like Petty, who had been practising physic for nearly twenty years."

A sufficient comment is to quote Graunt's own words.

"My next observation is, that of the Rickets we find no mention among the Casualties until the year 1634, and then but of fourteen for that whole year.

"Now the question is, whether that disease did first appear about that time; or whether a disease, which had been long before, did then first receive its name?"

"To clear this difficulty out of the Bills (for I dare venture on no deeper arguments) I enquired what other casualty before the year 1634, named in the Bills, was most like the Rickets; and found, not only by pretenders to know it, but also from other Bills, that Livergrown was the nearest. For in some years I find Livergrown, Spleen, and Rickets, put all together, by reason (as I conceive) of their likeness to each other."

Then he proceeds with his statistical analysis.

When a writer plainly tells you that he asked people who claimed to know, what other named disease might be confused with Rickets and that what they told him was, he thought, confirmed by the

grouping used in some of the Bills, why insist that he had a knowledge of "nice distinctions" which he explicitly repudiates?

We come now to the third point, that of the significance of Graunt's work on Life Tables. Lord Lansdowne does not seem to me to appreciate the nature of the problem. We may credit many people, including I believe some of the Roman jurists, with an appreciation of the importance of knowing how long persons of an assigned age were likely to live, but the difficulty was to obtain a numerical measure except by the method of actually recording the dying out of a generation. A much less intelligent person than Petty—who was a man of very quick intelligence—would perceive that if in addition to a knowledge of deaths at ages one knew the numbers of people living in the different age groups in a population, the solution of the problem might be reached. The passage from the *Petty Papers* which Lord Lansdowne thinks escaped my attention shows that Petty did realize that. He says, "The numbers of persons that are of every year old from one to 100, and the number of them that die at every such year's age, do show to how many years' value the life of any person of any age is equivalent, and consequently makes a par between the value of estates for life and for years." True he does not show how the calculation could be made, but as no such data as he required were available, or likely to be available, and Petty was a practical man, we need not complain. What, however, he did not see was that, under certain conditions, the table he wished to have could be calculated from a knowledge of deaths at ages only. That was Graunt's discovery, and the only contemporary who realized its immense importance was not Petty but Halley. Whether Graunt realized the limitations of his method, whether he recognized that, using as he did a growing population, his method under-estimated the probabilities of survivorship, is a nice question. The fallacy seems gross enough to us, but it would be an interesting experiment to take a dozen intelligent people without technical knowledge of statistics, to describe to them the process of constructing a life table by adding up the deaths in Graunt's way and to ask them to explain why, applied, say, to a current record of deaths at ages it will give wrong answers. I have never tried the direct experiment, but, judging from experience with students and from the fact that so intelligent a man as Edwin Chadwick did *not* realize the fallacy, I am not sure that it is one any intelligent person ought to detect at once. Halley, of course, recognized it, hence his attempt to secure data of a really stationary population.

What does seem abundantly clear is that Petty had no clear idea—as Halley had—of the significance of what Graunt tried to do. Almost a quarter of a century after Graunt's publication, we find

him asking for unattainable data, not like Halley trying to get better material to use in Graunt's way. I will provide Lord Lansdowne with a better argument tending to the intellectual credit of his ancestor than he has found for himself. Perhaps Petty *did* realize the fallacy of computing a life table from a knowledge of deaths only and carefully abstained from any financial applications because he knew that the method of Graunt gave incorrect results. Then, assuming that he really wrote Graunt's book, we must suppose that he afterwards discovered his mistake and, on that account, abstained from acknowledging his authorship. It *is* a little hard to believe that so zealous a calculator and projector whose arithmetical enthusiasm was never damped by lack of reliable data should, this time, have restrained himself from using so pretty an arithmetical tool as the life table, because it only provided a rather rough approximation to the probabilities of survivorship. Rough as the approximation may have been, it was closer than Petty's estimates of the world population or the growth of London.

These are major issues and, as I think, Lord Lansdowne has done less than nothing to shake the faith of those who, having read Graunt's book and Petty's arithmetical writings, believe that Graunt was a great vital statistician and Petty not a vital statistician at all. They will continue to think that Professor Westergaard quite correctly said of Petty that "the problems of vital statistics which Graunt discussed did not interest him at all." *

To those who have reached this conclusion, the secondary issues, Lord Lansdowne's parallel passages, the gossip of Petty's friends and so forth, are of minor interest. They may have some interest, perhaps, in the light they throw upon what literary critics conceive to be evidence. To a scientific worker, why the fact that Petty, in a memorandum made in 1671, noted that in 1660 he wrote observations on the Bills of Mortality, should be regarded as a formal acknowledgment of the authorship of a book published in 1662 under another man's name is a mystery.

Lord Lansdowne has printed four lists drawn up by Petty of his writings or projected writings. In one only of these (No. 158 of Lord Lansdowne's series) is there a reference to observations on the Bills of Mortality. If by that entry Petty *really* meant the statistical classic, are we to suppose that in 1685 and 1686 he had forgotten that he wrote it, although he remembered he had written the quite trivial comments on the Dublin Bills? Petty's testimony, it seems, is only to be trusted when it can be construed to have claimed something which was not his. Probably the construe does him injustice.

* *Contributions to the History of Statistics*, by H. Westergaard, London, 1932, p. 28.

There is no evidence that either in private or in public Petty ever did claim to have written the book published by Graunt. As to the chatter of Evelyn and the others, why it is "curious that their statements provoked no retort from Graunt's many friends when they were made, and that no one until comparatively recent times has felt tempted to take up the cudgels in his defence," Lord Lansdowne only knows. Just to oblige him, however, I will suggest that (1) Graunt's friends may possibly never have seen, for instance, a private letter from Southwell to Petty; (2) they may not have thought it worth while to contradict statements few would have heard and fewer still believed. I wonder how many of us have *not* heard that some good piece of work done by an investigator not otherwise famous was *really* inspired by somebody else!

Lord Lansdowne in his rejoinder makes some addition to our scanty knowledge of the relations of Graunt and Petty. One had gathered from Lord Edmond Fitzmaurice's biography that Petty was kind to Graunt and did not desert the man who had been so little worldly wise as to become a Papist. There is some further evidence that in his last years, financially broken and perhaps in ill-health, Graunt was not an easy man to help. Even in discussing these last years, Lord Lansdowne cannot forget his King Charles's head. "There is no attempt at 'ratiocination' upon any of the problems, political, medical, religious or statistical, which were continuously occupying Petty's mind and pen. If Graunt, as we are asked to believe, had really been the inventor of statistical science, if his was the mind which evolved an entirely new method of statistical analysis, if Petty owed to him in the first instance most of the ideas which he afterwards developed, it is surely inconceivable that there should have been no mention of such things in their Correspondence." Not to pause upon the facts, (1) that most of the matters which occupied Petty's mind and pen owed nothing whatever to Graunt; (2) that Petty did not develop *any* of Graunt's ideas, it does not seem inconceivable that letters written within two years of Graunt's death and, as it seems, concerned with Graunt and Petty's business relations and Petty's efforts to obtain employment for Graunt, should not have dealt with statistical science. Even men of genius have found poverty and ill-health hard to bear; when these troubles distress them, it is conceivable that their friends might not think the time favourable for asking their advice on scientific problems. It is, I know, quite normal that the parties to such a discussion as this should at its conclusion be of their original opinions. So it will be now. But if the controversy induces anybody who has not done so to read Graunt's book, it will have done more good than most literary discussions.

RECENT REPORTS ON TRANSPORT

THE proper economic adjustment of rail and road transport has attracted a great deal of attention recently and has evoked important contributions in the shape of reports from Committees presided over by Chairmen able to speak with considerable authority.

The Report of Lord Weir's Committee (1931) on the Electrification of Main Line Railways dealt with a special problem of railway operation, although it had its bearing on the power of the railway companies to hold or attract back again traffic which they have lost or are in danger of losing.

The First and Second Reports of the Royal Commission on Transport, presided over by Sir Arthur Griffith-Boscawen (Cmd. 3365 and Cmd. 3416 respectively), led to the passage of the Road Traffic Act, 1930, and to the establishment of a scheme of regulation and co-ordination of passenger services by road which is now in operation. Arising out of the application of this scheme to the special circumstances of London, the First Report of the Committee of Inquiry into London Motor Coach Services, over which Lord Amulree presided (1932), contained an interesting discussion of the extent to which the streets in the central area of a great city can reasonably be used for specialized forms of public passenger transport.

The Third and Final Report of the Royal Commission (Cmd. 3751), dealt with the general problem of co-ordination of all forms of transport and more particularly of road and rail. It has not yet been followed by legislative action, but two important developments have occurred since its publication in 1930. In the first place, the present Minister of Transport, under the powers conferred on him by the Railways Act, 1921, has recently consented to a pooling of receipts from all competitive traffics between the London Midland and Scottish and the London and North-Eastern Railway Companies. In the Report of the Committee appointed to advise upon this proposal (1932), Sir Walter Clode and his colleagues pointed out that, according to the evidence given before them, the pool would affect 50 per cent. of the traffic receipts of the two companies. This arrangement carries a step forward the co-ordination of the railway companies *inter se* which the Royal Commission recommended, and it is significant that, after certain assurances had been given by the companies concerned, the great trading organizations asked to be reported as supporters of the pooling scheme. The operation of the pool will not affect the figures on the expenditure

side of the separate accounts of the two companies (except, of course, in so far as it may conduce to economy), nor should the separate operating statistics published by the Ministry of Transport be vitiated. But the gross receipts appearing in the separate accounts will be the receipts as ascertained after the operation of the pool. Further agreements, based on similar principles, between the London Midland and Scottish and the Great Western Companies and between those companies and the London and North-Eastern Company have since been submitted to the Minister.

The co-ordination of goods transport by road and rail has equally recently been the subject of a striking and unanimous report from four leading representatives of the goods side of the road transport industry and the General Managers of the four amalgamated railway companies, under the skilled and impartial chairmanship of Sir Arthur Salter. The issues which underlie the present state of competition are disentangled and their relation to the public interest is discussed. Increased taxation on the heavier types of goods vehicles is recommended, and the establishment of some regulation of goods transport by road, which can only be secured by a system of licensing, is indicated as essential in order to bring about the equality of conditions upon which it is desirable and fair that competition between road and rail should take place.

The report of this Conference naturally led to many rejoinders from the various interests concerned which criticize the proposals both in principle and from the point of view of technical detail, and many of the arguments cannot be said to have been finally resolved.

While the various reports to which we have referred are, in the main, devoted to the discussion of economic issues, some of them contain a good deal of new statistical information relating either to the operation of the different forms of transport or to the volume of travel.

In the Salter Report, special interest attaches to the data used in the compilation of the ton-mile and petrol consumption statistics which form the bases of the Conference's allocation of the total annual figures of road costs—a figure which for this purpose is taken at £60 million net. These details are usefully reproduced in Appendix "C" to the Report. In addition to the numbers of vehicles ascertained by the Ministry of Transport's census in September, 1931, reduced to the equivalent numbers of annual licences, estimates are given for each main class of vehicle, and inside the goods class for vehicles at each taxation step in each of the sub-classes, of the average mileage run per vehicle per annum, the average laden weight per vehicle, the average petrol consumption in miles per gallon,

together with the resultant average ton-miles and average petrol consumption per vehicle per annum.

The Conference decided that they must find an appropriate statistical basis for allocating the total of road costs among the different classes of mechanically-propelled vehicles and applied themselves to this task with thoroughness and ingenuity. They first considered a system which they describe as a "speed-ton" factor. "It was proposed," they say, "to determine the licence duty for each class of vehicle by means of an index obtained by multiplying its tonnage by its normal speed per hour. For this purpose the legal maximum speed, where prescribed, was taken, and for private motor-cars and cycles, where there is no such maximum, a speed of 35 miles an hour was presumed." While agreeing that speed is a factor of which account must be taken, the ratio laid down in this formula was regarded as very questionable, and the whole method was rightly rejected by the Conference as too speculative and arbitrary and as one which would be clearly inequitable except upon the assumption of a certain rate of petrol duty.

The Conference next considered how far petrol consumption would provide an equitable criterion of incidence of highway costs. This criterion has the great advantage of distributing costs "justly and automatically not only between different classes but between different vehicles of the same class, the vehicle doing, say, 10,000 miles a year paying half as much as the similar vehicle doing 20,000."

Yet the Conference regarded this criterion as by itself "a defective measure of varying use and wear by different classes of vehicles, and this to an extent which would not be adequately corrected by the reservation of 20 per cent. of the total contribution for collection in the form of graded licence duties representing a general road franchise. This is largely due to the fact that in recent years the skill of the mechanical engineer has succeeded in securing a much greater result in work done in relation to petrol consumption in the case of the heavier vehicles. It will be a sufficient illustration of this to state that a light van of 24 cwts. laden weight does 18 miles to the gallon and a heavy lorry of 15 tons laden weight $4\frac{1}{4}$ miles to the gallon." It is obviously wrong that in the latter case "three times as much weight should be transported (although at a lower speed) over a given distance for the same petrol consumption and therefore petrol duty."

The Conference, therefore, agreed in rejecting petrol consumption as the sole basic criterion of the incidence of highway costs between different classes of vehicles, while accepting and employing it in their final proposal. They emphasize the point that "it is so valuable in securing a just incidence between different vehicles of the same weight and description—reflecting as it does both distance and speed

— that we consider that when the total contribution to be secured for each class has been otherwise fixed, there is a substantial advantage in collecting this total to as great an extent as at present by petrol duty.”

A third basis which the Conference considered was ton-mileage, but this again they were not prepared to accept as the sole and sufficient criterion. In their view ton-mileage needs correction at both ends of the scale to allow for speed, for differences in range and character of road use, and in certain cases for wear and tear not adequately measured by ton-mileage alone, even when regard is had to the use of pneumatic tyres and of additional axles and wheels in the shape of articulated and multi-wheeled vehicles.

After considering all the circumstances, the Conference concluded that a scheme of allocation based equally on ton-mileage and on petrol consumption would afford the most adequate and equitable general formula, subject to some further adjustments at each end of the scale in respect of the lightest and the heaviest vehicles. The result of the Conference's apportionment is to indicate that on a basis of user goods vehicles (with which alone the conference deals) contribute substantially too little towards the cost of the roads. The excess contributed by the private user has to be justified on sumptuary grounds. The fact that the Conference were able to agree upon a complicated statistical formula is interesting in itself and the particular data adopted deserve some notice. For cars taxed on horse-power—“the private car”—the Conference accept an average mileage per vehicle of 7,000 miles and an average petrol consumption of 20 miles to the gallon. To motor cycles an average annual mileage of 6,000 miles is attributed and an average petrol consumption of 90 miles to the gallon. The heavy omnibus and charabanc are assumed to run an average mileage of 36,000 miles and the heavier goods vehicles, many of them over 5 tons in weight, run an annual mileage of 18,500 miles.

The latest of the documents issued by the Ministry of Transport which we have to notice is that just published containing the annual reports for 1931 of the Area Traffic Commissioners appointed to license public passenger vehicles. To these reports the Minister has annexed a summary of the information contained in the statistical returns made to him by the various omnibus operators.

These returns show that the total number of persons carried by stage, express and contract carriages (excluding taxi-cabs) during the year 1931 was no less than 5,265 millions. The receipts from this traffic amounted to £58½ million, or nearly £161,000 a day. The average fare paid per passenger was 2.66 pence. The total number of vehicles which carried this traffic is given at 41,615.

The total figures are analysed to the extent of showing the number of vehicles and the proportion of the traffic carried by local authorities and by companies respectively.

If the new information be taken together with the annual railway returns and the annual returns relating to tramways, we now have a fairly complete picture of the volume of transportation provided by rail and road in Great Britain. In 1931 the freight traffic worked over the railways amounted to 16,322 million net ton-miles, and it is possible to estimate from the Salter Report that the corresponding figure for traffic by road was approximately 4,250 millions. In a recent report of the Interstate Commerce Commission it was estimated that in the United States motor vehicles carried, in terms of ton-miles, about $5\frac{1}{2}$ per cent. the total rail and road traffic in 1929 and that the proportion had subsequently increased.

On the passenger side, the number of seat-miles run over the railways of Great Britain seems to have been about 75,000 millions and those run by public service vehicles, tramcars, trackless trolley vehicles, and taxi-cabs may be estimated at approximately 70,000 millions; we may also assume from the Salter Report that private cars and motor cycles provided a further 30,000 million seat-miles. Ample facilities are thus provided for gratifying the modern passion for mere locomotion.

ESTIMATE OF THE JEWISH POPULATION OF LONDON IN 1929.

By H. L. TRACHTENBERG, B.A. (Cantab.), A.I.A., Member of the Statistical Committee of the Jewish Health Organization of Great Britain.*

Introduction.

THE difficulties associated with the presentation of a statistical analysis of the Jews of London are chiefly due to the fact that no census of the Jewish people has been taken, either in a direct form or as a question in the census of the general population.

The best that can be done is to make use so far as possible of the returns of burials in Jewish cemeteries, which are now in a complete state.

In his valuable paper read to the Royal Statistical Society in 1905, referred to below, Mr. S. Rowson described at length the features of the deaths registered by the Burial Society of the United Synagogue of London. In this paper he made an estimate of the Jewish population of London for 1903,† the figure he arrived at being 144,000.

In 1929, Dr. M. Sorsby ‡ by a different process confirmed Rowson's estimate and gave an estimate for 1928 of a minimum figure of 195,000.

It would appear that while Mr. Rowson's figure referred to the Administrative County of London, Dr. Sorsby's applied to Greater London.

The figure resulting from this last estimate would appear to be rather on the low side. Dr. Sorsby's method, which is explained below, was different from that now employed and accepted by the Statistical Committee as more reliable and more likely to be of service in future work.

Résumé of the Basis of the two Previous Estimates.(a) *Rowson.*

Mr. Rowson first calculated the approximate number of Jews in Stepney as follows :—

In the Sixty-sixth § Annual Report of the Registrar-General for

* A Report prepared for the Statistical Committee of the Jewish Health Organization of Great Britain.

† "A Contribution to the Study of the Vital and other Statistics of the Jews in the United Kingdom," by S. Rowson, B.Sc., *Journal of the Royal Statistical Society*, Vol. LXVIII, 1905, p. 526.

‡ "London Jewry," by Dr. M. Sorsby, the *Jewish Chronicle Supplement*, December, 1929.

§ Misprinted "Sixty-eighth" in the paper mentioned.

Births, Marriages and Deaths it was stated that the Jewish marriages in the five districts of London City, Bethnal Green, Whitechapel and St. George-in-the East * numbered 320 per 1,000 of marriages of all kinds. In these districts the number of the natives of Russia, Russian Poland and Roumania was given as 117.4 per 1,000. Mr. Rowson assumed that the natives of the above countries enumerated in the five districts mentioned consisted almost entirely of Jews. The former figure suggested that the Jewish population of these districts was 320 per 1,000, and hence the number of Jews $\frac{320}{117.4}$ or 2.74 times the number of the natives of these East European countries.

Hence in the Borough of Stepney, which at the time of the then last census (1901) contained 43,712 aliens whose country of birth was Russia, Russian Poland or Roumania, the estimated number of Jews was 119,770. But whereas practically the whole of the natives of these countries resident in Stepney could be assumed to be Jews, the same was doubtless untrue when the whole of London was considered. The total number of aliens from Russia, Russian Poland, and Roumania in the London area was 55,653. Mr. Rowson estimated 3,000 were non-Jews and multiplied the "balance of about 52,650" by the above multiplier 2.74, giving the number of Jews in London in 1903 as about 144,300.

(b) *Sorsby.*

Taking the number of Jewish deaths under one year of age in London for the years 1903 to 1927, for each sex separately, Sorsby estimated the number of Jewish births by assuming that the same infantile mortality rate applied as in England and Wales. He established that in this period on the whole no effect was produced by migration movements. Sorsby therefore took the Jewish population in 1928 to be that of 1903 plus the natural increase obtained from the births, reconstructed in the above manner, and the deaths obtained from the Jewish Burial Returns. Adding this natural increase on to Rowson's 144,000, Sorsby found 191,000 as a minimum figure for 1928, and for various reasons he increased this to a final minimum of 195,000.

(c) *The possibility of using either (a) or (b) as a method of deducing the official estimate for 1929.*

In attempting to make an estimate for 1929, the first step would be to examine Rowson's method for 1903 and Sorsby's method for 1928. We examine Rowson's method.

* The fifth district, dropped by a printer's error in the paper referred to, was Mile End Old Town.

He makes in the first instance the assumption that the marriage rates are similar in the Jewish and general populations.

The further assumption that the total number of Jews bears a constant ratio to the number of Jews of Russian, Russian Polish and Roumanian nationality is also questionable.

Mr. Rowson in fact only made use of it, even then in a modified form, outside the limits of Stepney because so large a proportion of Jews was concentrated in Stepney. As a matter of fact the ratio was not strictly based on the Metropolitan Borough of Stepney. It was based on five districts selected by the Registrar-General to illustrate illiteracy as evidenced in the inability of the population to sign the Marriage Register, a mark being made instead. The five districts were selected as those to which illiteracy was practically confined. They were London City, Bethnal Green, Whitechapel, St. George-in-the-East and Mile End Old Town. These included two registration districts outside the Metropolitan Borough of Stepney, viz. London City and Bethnal Green, while they excluded the registration district of Stepney.

When we come to the present day the diffidence with which one would proceed to apply such a ratio to the whole of London is increased.

In 1901, 79 per cent. of the natives of the three East European countries in London were in the Metropolitan Borough of Stepney, viz. 43,712 out of 55,653. In 1911 the proportion had decreased to 68 per cent., viz. 48,190 out of 70,952. In 1921 the proportion had further fallen to 53 per cent. (36,725 out of 69,011). The change is illustrated by the following Table showing the number of metropolitan boroughs in the Administrative County of London which had over 500 such natives at the 1921 census and the figures for the same boroughs in 1901.

It will be observed that whereas there were fifteen boroughs apart from Stepney, which had over 500 Russians, Russian Poles and Roumanians in 1921, in 1901 only four such boroughs existed.

From the above it is clear that the ratio is not of a nature which would be helpful at the present day. Actually the figures from which it was deduced were dropped from the official publication in 1915.

Coming to Sorsby's method, the assumption made in deriving the births from the deaths under one year of age, that the death-rate under one year of age is the same for the Jewish population of London as for the general population of England and Wales, would appear to throw the whole weight of the estimate on to a single factor.

Should the Jewish infantile mortality rate differ substantially from the infantile mortality rate of the general population, the estimate would be considerably deflected.

Russians, Russian Poles and Roumanians in Metropolitan Boroughs having more than 500 such persons at the census of 1921, shown for the censuses of 1901 and 1921.

Metropolitan Borough.	Number of Russians, Russian Poles and Roumanians at census of	
	1901.	1921.
Bethnal Green	3,544	6,119
Hackney	1,063	6,329
Hammersmith	102	548
Hampstead... ..	84	1,187
Holborn	375	735
Islington	328	1,440
Kensington... ..	367	1,993
Lambeth	166	722
Paddington	189	950
Poplar	283	1,042
St. Marylebone	449	1,580
St. Pancras... ..	555	2,035
Shoreditch	1,000	1,220
Stepney	43,712	36,725
Stoke Newington	101	1,111
Westminster	1,944	2,194

This possibility of a wide margin of error seems to be borne out by the consideration of Sorsby's results. Thus it seems incredible that while the deaths remained practically stationary, moving from 2,099 in 1903 to 2,008 in 1928, the births should have steadily fallen from 6,200 to 1,500. Taking the population as 144,000 and 195,000 (according to the estimates of Rowson and Sorsby respectively given above), this would mean that the birth-rate had fallen in the period of twenty-five years from 45.5 per 1,000 to 8.6 per 1,000 among the Jews in London.

(d) *The Committee's Estimate for 1929.*

The valuable death returns made by the Jewish Burial Societies to the Jewish Health Organization are not in themselves sufficient to deduce an estimate for the population without assumptions having to be made of one nature or another. As seen above, Dr. Sorsby availed himself of these returns for his natural increase method, but his procedure in deriving the births from the deaths under one year of age presents the difficulties indicated.

Unfortunately the returns of Jewish births at present made to the Board of Deputies are very incomplete. It is therefore impossible to use official returns of Jewish births, and the burial returns collected by the Jewish Health Organization present the only reliable data.

It seems to me that if one is going to make use of the deaths to give a population by applying to them an assumed death-rate, it is

better to do so not alone for the infantile portion, but for the whole population, age group by age group.*

One great advantage of such a procedure is that instead of births over several years being found and the possibility of a migration error over a considerable period being therefore present, the whole operation relates to one year, and the migration error is practically eliminated. The use of separate factors for each age group and sex allows for any differences of age and sex distribution in the Jewish deaths as compared with the deaths in the general London population. Further, the use of several age groups provides another advantage in that there is a fair possibility that errors in some age groups due to the assumption of the London proportions may have opposite directions in other groups and thus tend to cancel one another in the total. In Sorsby's infantile mortality rate, although a separate rate was used for each year, the errors are more likely to be systematic.

For the assumed death-rate I have taken the London figures instead of the England and Wales figures used by Dr. Sorsby, since the London Jewish population is being estimated. It may be mentioned in this connection that it has been shown † that in cities the Jewish death-rate tends to approach the general death-rate. The London rates, which are given ‡ in the form of population and deaths, are as follows :—

London Population and Deaths in 1929.

Age Group	Males.		Females.	
	Population.	Deaths.	Population.	Deaths.
0-	175,900	4,333	171,900	3,521
5-	352,200	715	350,100	629
15-	365,500	1,113	422,200	1,206
25-	321,200	1,284	404,900	1,244
35-	268,800	2,125	343,600	1,640
45-	252,400	4,009	301,900	2,898
55-	186,300	5,992	214,300	4,499
65-	90,300	6,735	118,100	6,615
75 and upwards . .	27,900	5,530	50,400	8,801
Total	2,040,500	31,836	2,377,400	31,053

* In an earlier method devised by Rowson, the results of which he also employed as a check on his method described above, he used more than one group in this way, viz. 0-4, and 45 and upwards. For ages 5 to 44, however, he used a different process.

† "Vital Statistics of Jews," by Leon Isserlis, M.A. (Cantab.), D.Sc. (Lond.). A paper based on material supplied by Mr. D. Tscherniakoff and Mr. J. Rumyanek and published in the *Ose-Rundschau, Zeitschrift der Gesellschaft für Gesundheitsschutz der Juden*, No. 8, August, 1930, pp. 6-10.

‡ The Registrar-General's Statistical Review of England and Wales for the year 1929 (see Tables Part I, Medical, p. 121, for London Deaths, and text, p. 98, for London Population).

The Jewish deaths for 1929,* to which I applied the proportions shown by the London figures, age group by age group, and for males and females separately were :—

Jewish Deaths in London in 1929.

Age Group.	Males.	Females.
0-	95	78
5-	35	47
15-	62	57
25-	68	63
35-	91	78
45-	200	122
55-	286	191
65-	264	237
75 and upwards	164	210
Total	1,265	1,083

The resulting populations are :—

Jewish Population in London, 1929.

Age Group.	Males.	Standard errors.	Females.	Standard errors.
0-	3,857	(± 396)	3,808	(± 431)
5-	17,241	(± 2,914)	26,160	(± 3,816)
15-	20,360	(± 2,586)	19,955	(± 2,643)
25-	17,011	(± 2,063)	20,505	(± 2,583)
35-	11,511	(± 1,207)	16,342	(± 1,850)
45-	12,592	(± 890)	12,709	(± 1,151)
55-	8,892	(± 526)	9,098	(± 658)
65-	3,540	(± 218)	4,231	(± 275)
75 and upwards	827	(± 65)	1,203	(± 83)
Total	95,831	(± 4,708)	114,011	(± 5,802)

The resulting total population is 209,842, viz. 95,831 males and 114,011 females, the standard errors being respectively, 7,472, 4,708 and 5,802. A slight addition must be made due to deaths of persons whose age was not given and who could not, therefore, be included in the age groups shown. These numbered $15\frac{1}{2}$ males and $7\frac{1}{2}$ females, the $\frac{1}{2}$ due to one whose sex was not given. Assuming the same age distribution holds respectively as for the deaths already distributed, the total population is raised by 1,174 males and 790 females giving final figures of 97,005 males and 114,801 females, i.e. a total population of 211,806 for 1929, with standard errors of 4,737, 5,822 and 7,506.

The question arose as to whether there were any cremations which were not included in the returns from the burial societies. From enquiries made of the Secretary of the Cremation Society it was ascertained that although the number of cremations not followed

* Being burial figures, these include a few deaths relating to the end of the preceding year.

by burial in a Jewish cemetery could not be definitely separated, the figure involved was too small to affect the final result to any appreciable extent.

It will be noted that since the burial returns have been made the basis of the estimate, the definition of a Jew as one who when he dies is buried in a Jewish cemetery has been retained. This means that in most cases of intermarriage the Jewish partner concerned is lost sight of, since he or she may no longer be buried as above. For this reason the estimate may fall short of expectations which visualize such person as still a Jew or Jewess, for compensation by the Gentile being buried in a Jewish cemetery is unlikely.

It has been assumed, in applying the London ratios to the Jewish deaths, that the London Jews can, as far as death-rates at the various ages are concerned, be treated as a random sample of the total London population, and it was therefore necessary to calculate the probable error of the estimated population in each age group and for the final total on this assumption.

Let N be the general London population in any group and d the general London deaths. Let d' be the Jewish deaths and N' the (unknown) Jewish population of the group. We estimate N' from our sample d' of Jewish deaths, $N' = \frac{N}{d} d'$.

Treating d' as a random sample from the total deaths d we have

$$\sigma_{d'} = \sqrt{N' \frac{d}{N} \left(1 - \frac{d}{N}\right)}.$$

Hence
$$\sigma_{N'} = \frac{N}{d'} \sqrt{N' \frac{d}{N} \left(1 - \frac{d}{N}\right)},$$

or approximately

$$\sigma_{N'} = \frac{N'}{d'} \sqrt{N' \frac{d}{N} \left(1 - \frac{d}{N}\right)} = \frac{N'}{\sqrt{d'}} \sqrt{1 - \frac{d'}{N'}}$$

approximately $= \frac{N'}{\sqrt{d'}}$ nearly if $\frac{d}{N}$ or $\frac{d'}{N'}$ is small.

Having calculated the standard deviations for the separate groups, the square root of the sum of the squares gives the standard deviation for the groups together, such as total Jewish population for each sex and total Jewish population.

The standard errors are shown in brackets against the respective figures.

Estimates for the Administrative County and the New Survey Area.

The deaths from the burial returns refer to Burial Societies serving not only the Administrative County of London, but the Outer Ring also.

The burial societies referred to are :—

The United Synagogue Burial Society.

The Federation of Synagogues Burial Board.

The Western Synagogue Cemetery, Edmonton.

The Liberal Jewish Synagogue.

The Union of Orthodox Congregations (Adath Yisroel) Burial Society.

The West End Chesed V'Ameth Burial Society.

The Spanish and Portuguese Jews' Cemetery.

The St. George's Settlement Synagogue and Burial Society.

The West London Synagogue of British Jews Burial Society.

It seemed desirable to separate the burials of persons who had been resident in the Outer Ring so as to produce a figure relating to the Jewish population in the Administrative County alone (see Appendix). This was done, and the Jewish Deaths in the Administrative County of London, age group by age group, which resulted, are as follows :—

Jewish Deaths in the Administrative County of London in 1929.

Age Group.						Males.	Females
0—	...	...	...	...	...	82	71
5—	...	...	...	...	...	31	36
15—	...	...	...	...	...	54	50
25—	...	...	...	...	...	59	54
35—	...	...	...	...	...	75	72
45—	...	...	...	...	...	179	107
55—	...	...	...	...	...	253	174
65—	...	...	...	...	...	226	205
75 and upwards	...	...	...	...	...	140	183
Total						1,099	952

The resulting population after applying the proportions shown by the general London figures on p. 91 are as follows :—

Jewish Population in the Administrative County of London in 1929.

Age Group.					Males.	Standard errors.	Females.	Standard errors.
0—	...	...	...	...	3,329	(± 368)	3,466	(± 411)
5—	...	...	...	...	15,270	(± 2,743)	20,038	(± 3,340)
15—	...	...	...	...	17,733	(± 2,413)	17,504	(± 2,475)
25—	...	...	...	...	14,759	(± 1,921)	17,576	(± 2,392)
35—	...	...	...	...	9,487	(± 1,095)	15,085	(± 1,778)
45—	...	...	...	...	11,270	(± 842)	11,147	(± 1,078)
55—	...	...	...	...	7,866	(± 495)	8,288	(± 628)
65—	...	...	...	...	3,030	(± 202)	3,660	(± 256)
75 and upwards	...	...	...	...	706	(± 60)	1,048	(± 77)
Total					83,450	(± 4,401)	97,812	(± 5,288)

Making additions for burials of 14 males and 7 females whose age was not given, the above totals become, 84,513 males and 98,531 females, or a total of 183,044 for the Administrative County, with standard errors of 4,429, 5,308 and 6,913 respectively.

The area covered by the New Survey of London Life and Labour included the Administrative County and also certain portions of the Outer Ring, viz. East and West Ham, Barking, Leyton, Walthamstow, Tottenham, Hornsey, Willesden and Acton. A further estimate was therefore made to correspond to burials relating to this New Survey Area.

The Jewish burials relating to persons resident in this area were as follows :—

Jewish Deaths in the New Survey of London Area in 1929.

Age Group.						Males.	Females.
0—	...	...	...	...	...	90	77
5—	...	...	...	...	...	33	41
15—	...	...	...	...	...	61	53
25—	...	...	...	...	...	63	57
35—	...	...	...	...	...	83	74
45—	...	...	...	...	...	192	112
55—	...	...	...	...	...	269	182
65—	...	...	...	...	...	253	225
75 and upwards	...	...	...	...	...	156	204
Total						1,200	1,025

The resulting populations after applying the proportions shown by the general London figures on p. 91 are as follows :—

Jewish Population in the New Survey of London Area in 1929.

Age Group.						Males.	Standard errors.	Females.	Standard errors.
0—	...	...	...	...	...	3,654	(± 385)	3,759	(± 428)
5—	...	...	...	...	...	16,255	(± 2,830)	22,821	(± 3,564)
15—	...	...	...	...	...	20,032	(± 2,565)	18,554	(± 2,549)
25—	...	...	...	...	...	15,760	(± 1,986)	18,552	(± 2,457)
35—	...	...	...	...	...	10,499	(± 1,152)	15,504	(± 1,802)
45—	...	...	...	...	...	12,088	(± 872)	11,668	(± 1,103)
55—	...	...	...	...	...	8,364	(± 510)	8,669	(± 643)
65—	...	...	...	...	...	3,392	(± 213)	4,017	(± 268)
75 and upwards	...	...	...	...	...	787	(± 63)	1,168	(± 82)
Total						90,831	(± 4,591)	104,712	(± 5,511)

Making additions for burials of 14 males and 7 females whose ages were not given, the above totals become 91,891 males and 105,427 females, or a total of 197,318 for the New Survey of London Area with standard errors of 4,618, 5,530 and 7,205 respectively.

It should be pointed out that although the Burial Returns give the permanent address, in many cases this is given as a place outside London, such as Brighton, Cape Town, etc. It has been assumed that such persons are connected with a London population and they have not been deducted whether the Jewish population of Greater London, of the Administrative County or of the New Survey Area has been concerned. It was impossible to assign them to any particular one of the three areas.

It only remains to summarize these results :—

Estimate of the Jewish Population of London in 1929.

	Males. Standard errors.	Females. Standard errors.	Total. Standard errors.
Greater London ...	97,005 (\pm 4,737)	114,801 (\pm 5,822)	211,806 (\pm 7,506)
The New Survey of London Area ...	91,891 (\pm 4,618)	105,427 (\pm 5,530)	197,318 (\pm 7,205)
The Administrative County of London ...	84,513 (\pm 4,429)	98,531 (\pm 5,308)	183,044 (\pm 6,913)

It is of interest to compare the proportions of Jews in the general population at the two dates of the present estimate and Mr. Rowson's estimate. This is done for the Administrative County in the following Table :—

Administrative County of London.

	General Population.	Jewish Population.	%.
1903	4,533,443	144,300	3.18
1929	4,417,900	183,044	4.14

The increase has therefore been considerable, the proportion rising from 3.18 per 10,000 in 1903 to 4.14 per 10,000 in 1929.

It is due to the initiative and suggestions of Mr. Rowson, the first Chairman of the Statistical Committee, that the Jewish Health Organization now receives regularly returns from the Burial Societies on a complete basis. The efficient manner in which the service of these returns is maintained reflects credit on Mr. Tscherniakoff, the Secretary of the Organization. Thanks are due to the officials of the Burial Societies concerned for their helpful co-operation. I should like to express my personal gratitude to Mr. Rowson, Dr. Isserlis, the present Chairman of the Statistical Committee, and Mr. Tscherniakoff for the facilities they have given me in the preparation of this paper.

APPENDIX.

I. The Administrative County of London consists of the Metropolitan Boroughs of:—

Battersea	Kensington
Bermondsey	Lambeth
Bethnal Green	Lewisham
Camberwell	Paddington
Chelsea	Poplar
Deptford	St. Marylebone
Finsbury	St. Pancras
Fulham	Shoreditch
Greenwich	Southwark
Hackney	Stepney
Hammersmith	Stoke Newington
Hampstead	Wandsworth
Holborn	Westminster, City of
Islington	Woolwich

and the City of London.

II. Greater London includes I and also the Outer Ring as follows, as laid down in the Census of 1921, the last Census prior to the date of the estimate of the paper. The accompanying sketch map, reproduced by kind permission of the New Survey of London Life and Labour, showing Greater London, the County of London and the New Survey Area, refers to 1928.

SURREY.

Urban Districts:—

Barnes, Beddington and Wallington, Carshalton, Coulsdon and Purley, Croydon (County Borough), East and West Molesey, Epsom, Esher and Dittons (part of, viz. the civil parishes of Thames Ditton and Long Ditton), Ham, Kingston-on-Thames (Metropolitan Borough), Merton and Morden, Mitcham, Richmond (Metropolitan Borough), Surbiton, Sutton, the Maldens and Coombe, Wimbledon (Metropolitan Borough).

Rural Districts:—

Epsom (part of, viz. the civil parishes of Banstead, Cheam, Chessington, Cuddington, Ewell and Woodmansterne), Godstone (part of, viz. the civil parishes of Addington, Farleigh and Warlingham).

KENT.

Urban Districts:—

Beckenham, Bexley, Bromley (Metropolitan Borough), Chislehurst, Crayford, Erith, Penge, Sidcup.

Rural Districts :

Bromley (part of, viz. the civil parishes of Downe, Farnborough, Hayes, Keston, Mottingham, North Cray, Orpington, St. Mary Cray, St. Paul's Cray and West Wickham).

MIDDLESEX.

Urban Districts :—

Acton, Brentford, Chiswick, Ealing (Metropolitan Borough), Edmonton, Enfield, Feltham, Finchley, Friern Barnet, Greenford, Hampton, Hampton Wick, Hanwell, Harrow-on-the-Hill, Hayes, Hendon, Heston and Isleworth, Hornsey, Kingsbury, Ruislip Northwood, Southall Norwood, Southgate, Staines, Sunbury-on-Thames, Teddington, Tottenham, Twickenham, Uxbridge, Wealdstone, Wembley, Willesden, Wood Green, Yiewsley.

Rural Districts :—

Hendon, South Mimms, Staines, Uxbridge.

HERTFORDSHIRE.

Urban Districts :—

Barnet, Bushey, Cheshunt, East Barnet Valley, Watford (part of, viz. the civil parish of Oxhey).

Rural Districts :—

Barnet, Hatfield (part of, viz. the civil parish of Northaw), Watford (part of, viz. the civil parish of Aldenham).

ESSEX.

Urban Districts :—

Barking Town, Buckhurst Hill, Chingford, East Ham (County Borough), Ilford, Leyton, Loughton, Waltham Holy Cross, Walthamstow, Wanstead, West Ham (County Borough), Woodford.

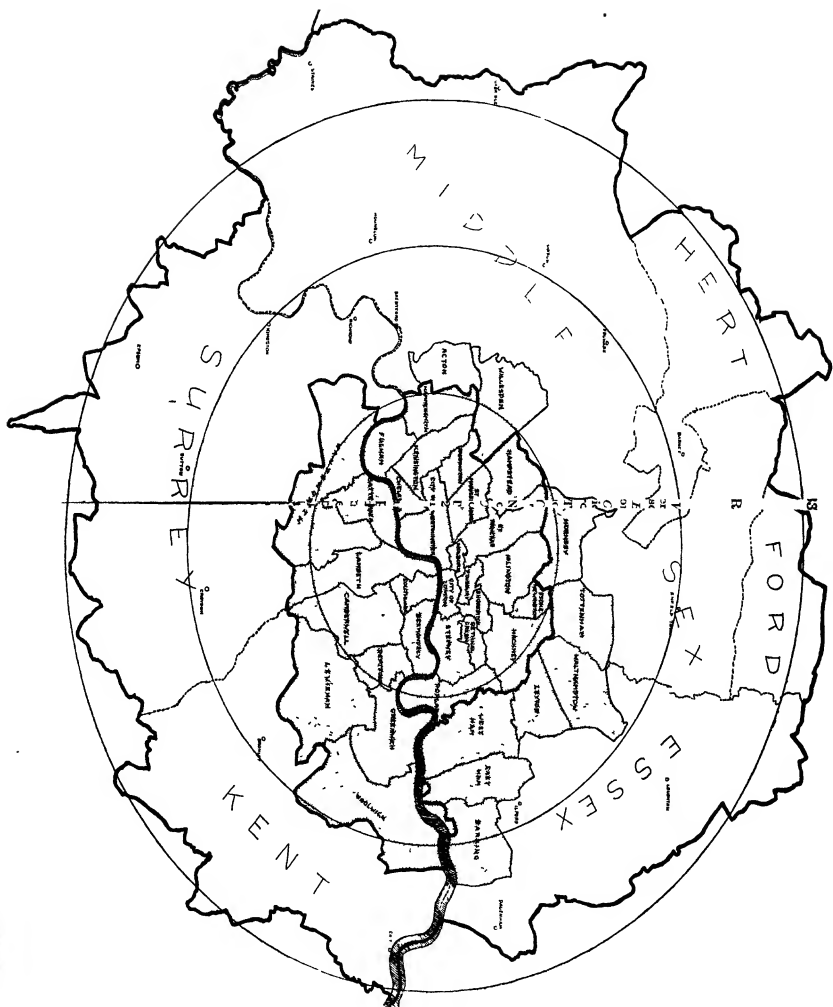
Rural Districts :—

Epping (part of, viz. the civil parish of Chigwell), Romford (part of, viz. the civil parish of Dagenham).

III. The Area of the New London Survey comprises I and the following portions of II :—

East and West Ham, Barking, Leyton, Walthamstow, Tottenham, Hornsey, Willesden and Acton.





REVIEWS OF STATISTICAL AND ECONOMIC BOOKS.

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1.—*Grundriss der Statistik*.—I. *Theoretische Statistik*. By Wilhelm Winkler. Berlin: Julius Springer, 1931. 9 $\frac{3}{4}$ " \times 6 $\frac{1}{2}$ ". ix + 117 pp. Rm. 10.80.

Here is another addition to the already considerable list of textbooks on statistics. The introduction discusses the organization of contemporary statistics, statistical sources, and the collection and compilation of data. The author considers three things necessary for the successful pursuit of statistics: first, practical experience, secondly, a knowledge of languages, and thirdly a knowledge of mathematics. Few statisticians would doubt the prime importance of the first, but opinions may differ as to the relative importance of the second and third. Professor Winkler, indeed, seems to regard mathematics as the most important language of all, "*So ist der mathematische Ausdruck die beherrschende Umgangssprache der moderne wissenschaftlichen Statistik geworden, und man muss diese Sprache lernen, wenn man die wissenschaftlichen Arbeiten auf diesem Gebiete verstehen will.*" Mathematical statistics in Germany has, he thinks, lagged somewhat behind, and the present book is an attempt to remedy the deficiency, using only elementary algebraical methods which will be understood by the wider class of readers he aims at attracting.

The development of the subject starts with the law of large numbers, and the normal curve is first illustrated by a practical case, and then arrived at as the limit of the point-binomial. Application is made to one or two simple sampling problems, and Lexis' theory of

dispersion follows. After a short section on tabulation, time series and frequency distributions are introduced, but the latter are discussed first. Averages and measures of dispersion lead on to a short discussion of the normal curve and of Charlier's, Edgeworth's, and Pearson's system of frequency curves.

Two methods of dealing with time series are discussed; one is Warren Persons' method of median link-relatives which first obtains the trend, then eliminates the seasonal fluctuations and leaves us with the cyclical fluctuations; the other method is to eliminate seasonal influence by means of a twelve-months moving average, then to eliminate cyclical fluctuations by some similar process of averaging, and to deal with the trend last. The latter method must be difficult if cyclical fluctuations are irregular.

A chapter on graduation and curve fitting follows; moving averages and least squares are shortly discussed, but the problem of fitting frequency curves is not dealt with. The example chosen for illustrating the χ^2 test is not very fortunate. It is applied to test the goodness of fit of a curve fitted to the populations of Germany in the years 1871, 1880, 1890, 1900, and 1910. The χ^2 test is only applicable to *frequencies*. Here it is applied to a *variate*. The distinction is fundamental, but occasionally, it seems, lost sight of.

Short sections on interpolation and extrapolation, on methods of comparison and on elementary treatment of correlation conclude the author's presentation of the subject. He devotes the last few pages to a discussion of the old question "Do statistics lie?" "No more," he concludes, "than any other science." Perhaps more interesting is his remark that in the course of his presentation of the subject he has shown how mistaken are the opinions of those people who think that the knowledge of the four rules of arithmetic *suffices* for a good statistician. The book is obviously a painstaking attempt to dispel this illusion in the quarters where it still lingers, though in other places the danger of divorcing mathematical theory from statistical practice may soon need equal emphasis.

J. O. I.

2.—*The Combination of Observations*. By David Brunt. Second Ed. Cambridge: University Press, 1931. $8\frac{1}{2}'' \times 5\frac{1}{2}''$, x + 239 pp. 12s. 6d.

A few changes have been made in this book in the second edition, but it remains what it has always been—a very valuable treatise on the method of least squares and on harmonic analysis. The chapters on frequency distributions and on correlation are—as far as the field they cover extends—good. In the new edition the description of the various types of Pearsonian curves which may arise for different values of β_1 and β_2 has been brought up to date. The explanation here is very clear and systematic, so that the student can easily see how the various types arise. A useful section has been added on partial correlation.

The chapter on harmonic analysis has been largely rewritten, and that on the periodogram modified in arrangement. Schuster's criterion must, as the author points out, be used with discrimination. If we have the squared amplitudes of, say, ten trial periods, we must

not apply Schuster's criterion to the greatest, and argue that if this is k times the average squared amplitude to be expected from a random series, the probability of a greater value arising by chance is e^{-k} . This is only a particular instance of a general principle that applies to all tests of significance. The necessary modification in this case has been pointed out by Sir Gilbert Walker; the modified probability would be $1 - (1 - e^{-k})^{10}$. Another correction is also necessary. The average amplitude has in practice to be estimated from the data, and this modifies the sampling distribution. The correct distribution has been worked out by Fisher, both for one harmonic term chosen at random and for the greatest of all the n possible harmonic terms that can be obtained from $2n + 1$ observations. In the former case the correct probability is $(1 - g)^n$, where g is the ratio of the square of the chosen amplitude to the sum of the squares of the n amplitudes, and in the latter, the result, for which Fisher gives the exact expression, does not differ greatly from $n(1 - g)^{n-1}$. J. O. I.

3.—*Applications de la Théorie des Probabilités à l'Astronomie.* Par C. V. L. Charlier. *Traité du Calcul des Probabilités et des ses Applications*, par Émile Borel. Tome II. Fasc. IV. Paris : Gauthier-Villars, 1931. 10" \times 6½". xi + 181 pp. 40 Francs.

This is a portion of the second volume of the great treatise on the theory of probability and its applications which is being edited by Émile Borel with the collaboration of numerous distinguished mathematicians.

We have now had the privilege of reviewing Professor Charlier's work in three different languages. Whether he writes in English, French or German, his work is always a model of lucidity. If all mathematical statistics were written as Charlier writes, the task of the student, and incidentally of the teacher and critic, would be enormously simplified.

The first chapter of the book is concerned with the following problem: "What is the probability that a comet with a given velocity at a given distance from the sun should have an elliptic or a hyperbolic orbit?" The problem is a classical one, and was considered both by Laplace and Schiaparelli, who came to contrary conclusions. The problem is studied by considering a three-dimensional space, with one axis for each of the components of velocity of the comet. To the velocity there thus corresponds a representative point in this space. If we consider only the visible comets, i.e. those whose perihelion distance is less than twice the distance of the earth from the sun, it is possible to show that the representative points corresponding to the velocities of these comets lie within a certain hyperboloid of revolution in the velocity space. A certain portion of this permissible space corresponds to elliptic, and the rest to hyperbolic, orbits, and this is the basis of the calculation. The results naturally depend on the frequency function assumed for the velocities.

If the mean components of velocity are zero, and all total velocities are equally likely, then, under the conditions obtaining in the

solar system, the probability of an elliptic orbit is large and of a hyperbolic orbit small. In this respect Laplace was right and Schiaparelli wrong. If while the mean components of velocity remain zero, the frequency function of total velocity is proportional to its square, then the probability of elliptic orbits is small and of hyperbolic orbits large. This conclusion in general remains true if the velocity components are normally distributed about zero, an exception arising if the dispersions are very small. If, however, the mean velocity components differ from zero, the probability of hyperbolic orbits tends in any case towards unity. In view of the fact that nearly all observed comets have elliptic orbits, the research justifies the conclusion that their mean velocities are zero, or that they belong essentially to the solar system, and have not met the sun fortuitously in its path among the stars.

The second chapter is concerned with a somewhat unusual probability problem, originally solved by Gylden.

The series

$$\sum \frac{k^{|i-i'|}}{i-i'}$$

where k is positive and less than unity and the summation is extended over all integral values of i and i' between $-\infty$ and $+\infty$, is one which is of importance in studying the perturbations of the planets. The series possesses the following property: If v_0 is any real quantity whatever, and δ any positive or negative number, then, however small δ is, there exist between v_0 and $v_0 + \delta$ an infinite number of values of v for which the above series converges, and also in the same interval an infinite number of values for which it diverges. This property gives rise to the following problem. "If v is chosen at random, what is the probability that the series will converge?" The series may always be reduced to one in which v is positive and less than unity, so that it is sufficient to study this case. The fundamental proposition in the solution of the problem is that if all values of v between 0 and 1 are supposed equally likely, and if v is expanded as a continued fraction $\frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \dots}}}$ then if the first n partial denominators are given any arbitrary integral values, the probability that a_{n+1} is greater than or equal to k is less than $\frac{2}{k}$. From this it may be shown that the probability of divergence of the above series is infinitely small.

The third chapter, fifty pages in length, starts by giving an excellent account of the properties of Hermite polynomials; their recurrence relations, their expression as definite integrals and as a solution of an integral equation of Fredholm's type, are all dealt with. Particularly important are certain expressions for their maximum values, as these are used in a discussion of the convergence of the type A series which follows next and is examined from three points of view. The chapter concludes with a discussion of the genesis of the type A series on the hypothesis of the combination of small influences.

The last chapter, about eighty pages in length, considers the problem of the frequency distribution of the velocities of the stars. Starting from expressions giving the relations between the components of velocity of two stars before and after passage close to one another, the author leads us up to Boltzmann's differential equation for the rate of change with time of the frequency function of velocities and co-ordinates and Maxwell's equation for the rate of change of the average value of any function of the velocities and co-ordinates. The author then expands the frequency function of velocities and co-ordinates in a type A series of the form

$$f = \Sigma A_{ijk} \frac{\partial^{i+j+k} \phi}{\partial u^i \partial v^j \partial w^k}$$

where

$$\phi(u, v, w) = \frac{n}{\alpha^3 (2\pi)^{\frac{3}{2}}} e^{-\frac{1}{2\alpha^2} [(u - M_1)^2 + (v - M_2)^2 + (w - M_3)^2]}$$

Here the functions A_{ijk} are in general functions of the co-ordinates and the time; u, v, w are of course the components of velocity. Maxwell's equation is then used to determine the rate of change with the time of the coefficients in the expansion. It is shown that the average values (M_1, M_2, M_3) of the components of velocity are independent of the time, and that the first order coefficients ($A_{100}, A_{001}, A_{010}$) in the above expansion vanish. Some thirty pages are then devoted to obtaining the rates of change with the time of the second order coefficients. The mathematics are here difficult, but owing to the extreme lucidity with which the work is presented, only time and application are necessary for their understanding. We wish we could do better justice to this portion of the work in a review. The final result is that the coefficients are of the form $e^{-3\alpha t}$, where $1/(3\alpha)$ is approximately 10^{16} years for the stars in the galactic system. Thus in 10^{16} years these coefficients would be reduced to about 37 per cent. of their original values, and would ultimately vanish. Similarly, the other higher order coefficients tend to zero at varying rates, and the frequency distribution of velocities ultimately becomes stable and normal.

J. O. I.

4.—*Tables for Statisticians and Biometricians*. Edited by Karl Pearson, F.R.S. Part II. London: Issued by the Biometric Laboratory, University College. 1931. 11" \times 8½". ccl + 262 pp. 3os.

As long as everyone is occupied in the search after truth, it matters little if all arrive at different conclusions.—Joseph Priestley.

When there is much desire to learn, there of necessity will be much arguing, much writing, many opinions; for opinion in good men is but knowledge in the making.—John Milton.

With the above two quotations Professor Karl Pearson opens the second volume of *Tables for Statisticians and Biometricians*, which incorporate all the tables published in *Biometrika* since Volume I was issued in 1914. It is doubtless in the spirit of these maxims that Professor Pearson would like to see the work criticized.

There are fifty-six tables, occupying 262 pages, and an introduction of no less than 250 pages explains their use. The latter, in spite of the disclaimer of Professor Pearson's preface, gives an admirable outline of the methods of the Biometric school.

The introduction starts with useful notes on formulæ for transition from frequencies to ordinates and vice versa, and on methods of interpolation into tables of double argument, while the first three tables in the volume are tables of functions related to the probability integral. The first of these gives ordinates of the normal curve to five figures for each per mille of frequency; its principal use appears to be in expressing non-quantitative variates on a normal scale. The second is a table to ten decimals for each per mille of frequency of the abscissæ and ordinates of the normal curve and of the ratios of areas to bounding ordinate $\left(\frac{1}{z}(1 + \alpha)\right)$ and their reciprocals.

The third is an abridged form of the second. The latter two tables find application in approximating to the tails of certain frequency distributions and in summing a limited number of terms of a binomial.

Table IV occupies fifty-six pages. It is a table, calculated by Woo, for testing the significance of the correlation ratio. We are given the mean and standard deviation of η^2 , in sampling from an infinite universe in which there is no association and the arrays normally distributed, for every size of sample from 50 to 1000 and for every possible number of arrays from 3 to 20. For each entry we are given the values of the ratio

$$\frac{\text{observed } \eta^2 - \text{Mean } \eta^2}{\text{Standard Deviation of } \eta^2}$$

which will correspond to probabilities of 0.01 and 0.02 of occurrence. The table may also be used to test the significance of the multiple correlation coefficient which, in sampling from populations in which the coefficient is zero, has a distribution of the same form as that of the correlation ratio. In the reviewer's opinion, the significance of the correlation ratio can be more simply tested by an easy application of Fisher's "z" test, his published two-page table being usually all that is necessary. However, Woo's table gives us a mass of detailed information about the distribution of η^2 which is not available elsewhere.

We next find sixty-four pages of tables primarily related to the problem of determining the correlation coefficient from a fourfold table on the assumption of normality. There is a table of the first twenty tetrachoric functions or successive differential coefficients of the probability integral. Pearson's definition of this function is

$$\tau_0(h) = \int_h^\infty \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2} dx$$

$$\tau_s(h) = \frac{(-1)^{s-1}}{\sqrt{s!}} \frac{d^{s-1}}{dh^{s-1}} \left(\frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}h^2} \right)$$

and is tabulated for values of h at intervals of 0.1 from 0.0 to 4.0 and for integral values of s from 0 to 19. This table is a useful

addition to the table of Vol. I, in which the first six tetrachoric functions are tabulated at intervals of one-thousandth of τ_0 . For interpolation 4th differences are in general required, and two auxiliary tables are given to facilitate the calculation of these. The functions are, of course, essentially those which occur in the Gram-Charlier series.

There follow tables of the volume of the positive quadrant of a fourfold table in terms of the distance of the dichotomic lines from the mean and of the correlation coefficient. Calling h and k these distances in terms of the respective standard deviations, and r the correlation coefficient, the volume is given at 0.1 intervals of h and k from 0.0 to 2.6 and for positive and negative values of r at intervals of 0.05. For positive correlations we have six decimal places, and for negative as a rule seven, but additional places are given when the number of significant figures decreases. There is a wealth of illustration of the application of these tables in the introduction, and methods of interpolation are fully described. Most of the examples are concerned with the calculation of fourfold correlation coefficients, but the problem of determining the theoretical contents of any cell of a correlation table *on the assumption of normality* is fully dealt with.

It is possible to maintain that the importance of tetrachoric correlation coefficients has been somewhat over-estimated, that a simple test of significance carried out by the χ^2 method or the equivalent comparison of the difference of two percentages with its standard error is as a rule all that is justifiable or required, the further assumption of normality involved in the calculation of tetrachoric correlation coefficients being hard to substantiate. On the other hand, the adherents of the opposite view will argue that even if our two variates are not normally distributed, we can find functions of them which are. When our data are qualitative in form, and no direct test is possible, the reader must decide between these two views according to his taste, his experience and his needs.

The tables so far mentioned occupy more than half the book. The remainder contains tables related to a number of special problems. Among these are tables for calculating the frequency distribution of the first product movement coefficient and tables for calculating the probable error of the mode of Pearsonian frequency distributions, tables of the probability integrals of symmetrical frequency curves and a number of tables relating to the frequency distribution of the range. The latter are among the most important in the book. The range is a very useful statistical estimate, and one easily comprehended by the layman.

The tables connected with the frequency distribution of the correlation coefficient deserve special mention. They are likely to remain the most promising source for those who desire detailed information, especially of a graphical nature, about the *form* of the distribution of the correlation coefficient in small samples for varying values of the correlation of the population sampled. The tables of the differences of the powers of zero, of inverse factorials, of the reciprocals of the first hundred integers all to a large number of

decimal places, as well as the first ten powers of the first hundred numbers, are likely to be generally useful, while the table of certain standard constants to thirty decimal places will save much searching for the computer who occasionally requires a greater number than those usually given.

In conclusion, we cannot but admire the patience and industry of Professor Pearson and his colleagues in producing this volume. Professor Pearson is fond of mottoes, and usually chooses apt ones. To this the first page of this book bears witness, and further instances will occur to those familiar with the mural decorations of the Galton Laboratory. His own should be "*Si monumentum requiris circumspice*," for in almost every branch of science to-day we can trace the influence of the statistical methods first used in the Galton Laboratory. To have held a chair for some forty-five years, and to look round, still in the fulness of vigour, and survey the fruits of one's labours, is a privilege that Providence grants to the very few.

J. O. I.

5.—*Statistics in Theory and Practice*. By L. R. Connor, M.Sc. (Econ.). London: Pitman. 1932. 8 $\frac{3}{4}$ " \times 5 $\frac{1}{2}$ ". 371 + xvi pp. 12s. 6d.

"This is the Age of Statistics," says the author, and many persons in different walks of life are becoming statisticians, without knowing it, of one sort or another. The statistician may properly be concerned with the collection of information relating to individual units which form a group in which he is interested, with the assembling and presentation of the data so acquired into a form suitable for digestion by others, with the analysis of such data in the form of tables, an analysis which seeks to rive from the tabular rock the hidden gold of norms and tendencies, or with the interpretation of the results of such analyses, their relation to other known facts, and with the probable future course of events of a nature akin to those which have been the subject of enquiry. Whether it is the business man, who arranges to have the information relating to his business in such a form that he can use it for the proper understanding of what is happening, and so that he can relate the facts of his business to other facts concerning the world outside, whether it is a student of affairs who wants to understand the facts relating to the people of a country, their social well-being, the trade of the country and the like, or whether it is a research student interested only in an isolated problem, all are ultimately concerned somehow in knowing something of the methods of handling statistics, and something of their limitations. Thus a politician would never write a letter to *The Times* pointing out that trade was on the mend, urging as his reasons for this conclusion the fact that the December Exports of United Kingdom Produce were greater in value by 3 per cent. than the corresponding figures for the previous November, because he would first of all enquire exactly to what period of time the November and December figures relate, whether 30 days or 31 days are involved; he would consider whether the symbol £ before his figures meant the same thing at the different periods, he would find out from previous

experience whether there was any seasonal movement in trade figures, and so on.

Unfortunately, in the normal course of events it is seldom that the functions of the "complete" statistician are performed by one person. He who finally interprets the results may not know anything about the method of collection of the original data. This is a pity, because if he did know, he might sometimes realize that the figures are not sufficiently precise to bear the weight of argument which he tries to impose upon them. The person collecting the original information, or he who assembles the original data into a tabular form, is often not concerned with the data beyond that state. This again is to be deplored, because if they knew something of the uses to which the statistics were to be put later, they might conceivably handle the material slightly differently from the beginning with subsequent gain. Although this division of labour is inevitable in modern times of mass production, it is really necessary that each participant in a process should know something about the ultimate product in which all are engaged. For those handling statistics at any stage Mr. Connor's book serves as an admirable guide to the various processes to which statistics submit in the course of being turned from raw materials in schedules, day books, card indexes, etc., to graphs in the manager's office, or figures in books, or answers to questions in the House of Commons.

Part I consists of a description, brief and to the point in many cases, of a multitude of "methods" which are used by the statistician. Each description is illustrated with examples drawn from many sources, some of them astronomical (Right Ascension of *Polaris*), some of them Banking (Monthly Returns of Advances—London Clearing Banks), some wages (weekly), some Prices (Board of Trade index-number of wholesale prices), and many others. Anyone can easily understand how to work the method by consulting the illustration. Some of the methods involve a knowledge of elementary considerations of mathematical probability, and some also a knowledge of more mathematics than most persons possess. But, as far as the simpler methods are concerned, and these are the methods most usually applied by all statisticians except the research student, the mathematics necessary for a right understanding are a minimum.

Part II consists mostly of statistical information. The topics considered are those of interest to most persons and comprise Population, Prices, Wages, Employment, Profits, Trade, Finance, Production, Wealth. For the most part the information given on these relates to the United Kingdom. Anyone wishing to know the recent relevant figures relating to such subjects will find them here with a description of the data which are given.

In addition, Part II has two chapters of interest to business men, the one on Business Barometers and the other on Business Statistics. The first consists of a description of various indices of Business Activity, their construction, etc.; the other consists of an indication of the kind of statistical records which are usefully kept by business firms.

The author states that the book will cover all the requirements of those reading for professional examinations, and the publishers state

that "Students for professional examinations will find the book invaluable." Probably the students will find within the covers of the book far more than they need for their professional examinations, and the more intelligent of them may consider the last chapter, wherein they find for the first time the secrets of the statistics handled by businesses, rather disappointingly small; but it is hoped that they will obtain relief when they read these words in that chapter: "As a matter of experience, the student will find simple comparisons by tables and graphs (natural and logarithmic), averages, ratios, percentages, and index-numbers the most effective for normal business purposes, the rest of his equipment should be reserved for special occasions."

E. C. R.

6.—*The New Survey of London Life and Labour*. Vol. III. Survey of Social Conditions. I. The Eastern Area. xvi + 475 pp. Vol. IV. Social Survey. I. Eastern Area Maps. London: P. S. King & Son, Ltd., 1932. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. 17s. 6d. each volume.

In the present volume, and its companion volume of maps, the New London Survey reaches the social and economic problem the solution of which was, in the Survey's inception, its main objective, viz. the measurement of the incidence of poverty in London and its comparison with the conditions prevailing at the time of Charles Booth's investigation. The Eastern Survey Area, to which these volumes are devoted, is the first section of London to be dealt with, and covers not only the "East London" to which Charles Booth gave his attention, but includes also six boroughs beyond the Eastern County boundary (West Ham, East Ham, Barking, Leyton, Walthamstow and Tottenham), and five boroughs of South-East London (Bermondsey, Deptford, Greenwich, Woolwich and Lewisham), the total population being nearly two and a half millions. The economic conditions prevailing in this large and thickly populated area have been investigated along two lines, which may be characterized as intensive and extensive. The intensive study, described as the "House Sample Inquiry," has been made on similar lines to those employed in the well-known investigations carried out by Professor Bowley and his colleagues in Reading, Warrington and other provincial towns in 1914 and 1924, and it is a matter for congratulation that Professor Bowley himself has been in charge of this part of the Survey. Under his direction data were obtained from over 12,000 working-class households, the sampling factor varying somewhat over the area owing to the small size of some of the boroughs. This line of enquiry, in addition to the information it provides on the basic problem of poverty, has produced as well a considerable and valuable addendum to the more limited material available from the national census, especially with regard to the constitution of working-class families, their earning strength, incomes, rents and housing conditions.

The extensive method of investigation (the "Street Survey" directed by Sir H. Llewellyn Smith) has followed more closely the methods adopted by Charles Booth, being primarily based on an examination of the conditions prevailing in families with school

children in all streets in the Survey Area. The most fertile source of information was, it is stated, the knowledge and experience of School Attendance Officers, supplemented from such sources as Employment Exchanges, the former Boards of Guardians, and the Police. The results are an approximate classification of the inhabitants of each street in four economic grades, the local distribution being shown graphically in five of the maps in Vol. IV.

Broadly stated, these two lines of investigation agree in showing that the percentage of the population of this Eastern area who were below the "poverty line" at the time of investigation was only about one-third of the percentage found by Charles Booth forty years earlier, and this is in spite of the presence of such tendencies as that of the more prosperous families to migrate from the central areas to the suburbs. The Street Survey shows in particular the diminished local concentration and greater dispersion of East London poverty. On the other hand, the authors clearly emphasize that there has been no attempt to fix a level of present-day "poverty" according to present-day ideas. The sole aim has been to apply Charles Booth's standard to present economic conditions. On those grounds it may be argued that the level of poverty has been fixed too low, but it is shown that with a higher level the result of the comparison with forty years ago would not be substantially altered, provided that a uniform standard were used throughout. One of the most striking, and most disturbing, facts brought out is that nearly one-half of the persons found to be in poverty in the week of investigation owed their condition at the time to unemployment and under-employment, while low rates of wages, so important in Charles Booth's day, are no longer a major cause. In other words, to use Sir Llewellyn Smith's terms, there has been a relative increase in "dynamic" poverty as compared with "static," so that the present volume of poverty may be accompanied by a greater amount of unhappiness than formerly. The position has without doubt greatly improved, but it is still not to be regarded with complacency. For instance, it is unsatisfactory to find that the reduction which has taken place in average density and total overcrowding has been accompanied by some increase in the proportion of the population living under conditions of very acute congestion, and that, according to the standard adopted, there is a very high proportion of children in the more over-crowded boroughs for whom insufficient bedroom accommodation is provided. A special chapter is devoted to this subject of housing, and one of the maps of Vol. IV illustrates the incidence of over-crowding. Other studies include the relationship of old age to poverty, unemployment to poverty, the problem of the homeless poor, the street-trading community and the hop-pickers' migration. In a final section the basic statistical facts are set out for each borough, accompanied by a brief summary of their topographical, economic and social characteristics.

This short account of some of the more important methods and conclusions cannot, it will be obvious, do justice to a volume that adds to its valuable collection of statistical material an invariably interesting account of so many aspects of London life. A. B. H.

7.—*The National Income, 1924 1931.* By Colin Clark, M.A. London: Macmillan. 1932. $8\frac{1}{2}'' \times 5\frac{1}{4}''$. x + 167 pp. 8s. 6d.

The two estimates of national income for Great Britain and Northern Ireland generally accepted for use in the past few years are those of (a) Bowley and Stamp and (b) Flux. The main basis of the former estimate (referring to 1924) was the Income Tax Assessments, these accounting for about 60 per cent. of the total of £4,200 million. The main basis of the latter (also referring to 1924) was the "net output" of industry and agriculture as furnished by the Censuses of Production of Industry and Agriculture for that year, accounting for about 65 per cent. of the £4,000 + 200 million. In the case of Bowley and Stamp, on top of the main foundation, for which the estimate was probably correct within a narrow limit of error, estimates with a much wider margin of possible error had to be made for (a) wages falling below the income tax limit and (b) other incomes. In the case of Flux, the main estimate again was probably subject to only a small margin of error, but this had to be supplemented by an estimate for the very considerable section of income not derived directly from industry or agriculture. Flux did not attempt a detailed analysis of this balance and stated that his calculations relating to it were "obviously very rough." There was thus a close accordance between his final result and that of Bowley and Stamp, but it has been suggested (*Journal R.S.S.*, Vol. XCIV, p. 385) that a more detailed investigation of this balance would lead to a higher figure than he accepted. Further research into the subject accordingly is fully warranted. Recently Dr. Coates, in an address before the Manchester Statistical Society, gave an estimate for 1931 of £3,850 million, his method being based on Income Tax Assessments.

Mr. Clark states that he "set out to make a detailed and more or less final evaluation of the national income for 1924 and for 1928 with estimates for the intervening years and up to 1931." Subsequently the book proceeds to an analysis of how the national income is produced, distributed, and spent. It is not an easy book to review. To perform the task adequately one would require to work through the book paragraph by paragraph and sentence by sentence, and to check the calculations and the reliability of the assumptions on which the estimates are based. If this were done the review would be as long as the book itself, which in parts is very compressed.

The main defect of Mr. Clark's work is that he does not seem to possess sufficient critical faculty to scrutinize his own results as they are reached and, if they seem improbable, to re-examine the data for the purpose of ascertaining if there is a concealed "snag" in them. In dealing with material of the kind handled in this investigation it is particularly necessary that the results should be examined at every stage and discarded if they lead to conclusions which are obviously untenable. This weakness is prominent almost from the start of the book. In Table V, Mr. Clark provides figures of the number of "employers and independent workers" in Great Britain in five groups for the years 1911, 1921, and 1928, the totals for the three years for males showing the surprising sequence: 1911, 1,915,000, 1921, 1,492,000; and 1928, 1,235,000. (In the "Com-

merce" group Mr. Clark gives a figure for males for 1928 less than half that for 1911.) He states that the figures "for 1921 are largely derived from the estimates of Bowley and Stamp, and for 1911 from *The Division of the Product of Industry*" (though actually they differ very substantially in certain particulars from the figures published by Professor Bowley in that book). He further states that "the figures for 1928 are estimated in the light of the trend from 1911 to 1921," a pleasanter phrase than the statistician's more usual term "extrapolation," and one which may mislead the uninitiated but is hardly likely to deceive the reader with experience of this class of statistics. The surprising sequence of the figures should have led Mr. Clark to have examined the Census volumes themselves. He would have found that for 1921 the Census volume provides actual figures of "employers and independent workers" in each occupational group and also a total. In 1911, however, the Census volume only gave these particulars for *certain* groups and did not provide a total. Dr. Bowley, writing before the results of the 1921 Census were available, stated that he attempted in 1911 "to classify the occupied persons . . . according to their status in industry, *for which only rough estimates can be made.*" Dr. Bowley in fact had to make certain guesses, and it is clear from the figures subsequently available for 1921 that, though they were probably quite better guesses than anybody else would have made, they were a considerable distance from the truth. But it seems unpardonable for Mr. Clark, many years after the 1921 figures were available, to use guesses relating to 1911 as the basis of extrapolation to obtain figures for 1928. It is certain that his figure of 1,235,000 for 1928 is some hundreds of thousands in error, and it is probable that the correct figure was about 30 per cent. higher.

This error almost at the beginning of Mr. Clark's work influences many of the subsequent estimates. The estimate of "employers and independent workers" is used in the construction of another table (Table IX) computing the number of salary earners. This shows an increase from 1,715,000 salaried workers assessable to income tax in 1921 to 2,420,000 in 1928, a rate of increase so surprising that it should surely have arrested the attention of Mr. Clark at some stage between the first calculation and the final approval of the proofs of the book. The error in under-stating the numbers of "employers and independent workers" has led to an error of substantial magnitude in over-stating the number of "salary earners."

The next stage is to determine the number of wage earners, but the error which led to under-statement of the first group and over-statement of the second group still influences the calculation and leads to an under-statement of the number in the group of wage earners. Mr. Clark obtains a figure for wages in 1924 no less than £200 million below the Bowley and Stamp figure for that year. "This difference," he says, "is due to a lower estimate of numbers much more than a lower estimate of average earnings." He claims that his method should give a better basis for estimating the number of wage earners than that of Bowley and Stamp (his figure is nearly

one million less), since he has used the statistics of social insurance in place of estimates based on the Population Census. Whether or not this additional material, with all the difficulties involved in interpreting it, really does throw more light on the problem it is not possible to say, since Mr. Clark's work on this part of the problem is vitiated by the effect of the fundamental error.

At one stage of his work Mr. Clark requires to determine the average income of the "employers and independent workers" who are below the income tax limit, a number which he estimates was 565,000 in 1928, though it is highly probable that this figure is considerably below the truth. To determine this average income he uses the following distribution of "*net* (whatever that may be) income per week" obtained from an enquiry conducted in the neighbourhood of Liverpool which, he claims, furnishes "a sort of microcosm of the situation in the country as a whole":—

	Net Income per Week.			
	Under 20s	20s. to 25s.	25s. to 30s.	30s. to 100s.
Number of Workers in Enquiry	170	102	106	218
Average Earnings (shillings per week)	20·7	40·0	55·2	74·8

No statistician who surveys for a moment the characteristics of this distribution could be deceived into accepting the figure of net incomes of the 378 people, particulars of which were obtained by personal enquiry, as a random sample of the ordinary income of the 565,000 (or possibly 700,000) in the whole country receiving less than £3 a week. The probable error in an average determined from a sample of such insignificant size (0·05 per cent.), even if it were truly a random one, is very large indeed. Mr. Clark concludes from it that the average *net* income of the 565,000 persons (with a higher limit of £159) was £96, but knowledge of the character of the frequency distribution of incomes in general suggests that the average for the half-million or so who are at the left-hand tail of the general distribution is more likely to be nearer to £120.

The unscientific character of Mr. Clark's method of estimating is well brought out in his chapter on "Industrial Production." In this he expands some of the work he submitted to the Macmillan Committee on the development of industrial production in this country after 1924, the last year for which Census of Production figures were then available. His method is "to combine industries in groups suitable for the comparison with unemployment statistics." The value of production for each group is then estimated for each of the years from 1927 to 1931 by multiplying the value of the output in 1924 by three factors—(1) the proportionate change in the number of persons at work, (2) a price factor based upon the average value of

exported articles, and (3) a factor representing the increased physical volume of gross output per employed person. Mr. Clark does not show his results under each group, but states that "the errors in them are probably accidental rather than systematic, and therefore they may be considered reliable for use in estimating a total, but not for use as individual figures." Such a statement may mislead many of the readers of the book who have not the opportunity of forming their own judgment on the point. The use of "export values" as a guide to production prices is notoriously inaccurate, and is in itself sufficient to cause competent readers to distrust the results obtained. Although in this volume he does not publish the figures under the separate headings (a procedure which is to be strongly deprecated in a book of this type, since it deprives the reader of the means of forming a judgment on the methods used and the results obtained), in the evidence he submitted to the Macmillan Committee Mr. Clark provided some, at least, of the figures involved (Cmd. 3897, Appendix VI, Table 3, p. 311). They were truly astonishing. They purported to show, for example, that in one industry the net output per person employed increased from £190 in 1924 (as given by the Census of Production for that year) to £245 in 1928 (the true figure in 1930 given by the Census of Production Report for that year subsequently published was £188. It is difficult to pardon Mr. Clark for errors of this character. He could have readily inferred that, if his results had been correct, the industry referred to had increased its profits between 1924 and 1928 by no less than £9 million in spite of the fact that it had in the same period lost 14,000 of its employees, and reflection would then have suggested that there was some serious fallacy in the reasoning which led to such a result. The fundamental error in this case lay in assuming that "net output is proportional to gross output," which means that the cost of materials used in manufacture and the value added by labour and capital move in the same direction and in the same proportions. Living in a period of unprecedented price changes there can be no justification for failing to detect the mistake in making such an assumption. The statistician's solace that errors tend to cancel when results are aggregated must not be relied upon too much. In the type of problem dealt with by Mr. Clark in this chapter on "Industrial Production" we are not justified in assuming that positive and negative errors are equally likely, and therefore that the net sum when they are aggregated is negligible. The results stated in this chapter are so highly speculative that we can only advise waiting until the full results of the 1930 Census of Production are available before they are even discussed. Some at least of the calculations made by Mr. Clark in this book have been made by other people who, on close scrutiny of the results, have rejected them. The desire to obtain an index as a short cut to knowledge on a particular subject (*e.g.* the increase in recent years in industrial output per person employed) lies deep in the statistician's heart, and he should be encouraged to examine all suitable material for this purpose, but he should develop at the same time a critical faculty and a determination to examine the results he obtains and to reject them if they are obviously unlikely. He should also make sure that

his data are correct and thus avoid errors like the statement on p. 122, that milk "does not appear to be included" in the Board of Trade index of wholesale prices.

Readers of the book may be puzzled by a statement in the Introduction referring to an opinion expressed by the Federation of British Industries in reply to an official inquiry regarding the collection of certain statistics. The statement is erroneous and misleading and it is to be feared that many people may regard Mr. Clark's book as supporting the contention of the Federation of British Industries, that the expenditure of public money in the collection of statistics can only be justified at the present time if the interpretation of them is critical and intelligent. E. C. S.

8.—*The Economic Lessons of 1929–1931.* The first eleven bulletins of the Unclaimed Wealth Utilization Committee, Geneva. London: P. S. King. 1932. 8 $\frac{3}{4}$ " \times 5 $\frac{3}{4}$ ". vii + 94 pp. 4s. 6d.

The Unclaimed Wealth Utilization Committee was formed in 1931 under the chairmanship of A. H. Abbati "to urge that the existence of unemployed labour, unemployed capital equipment and unemployed surplus stocks of goods is largely the result of insufficient buying by the creditor countries and creditors in general from debtors, whereby a surplus of goods and services made available by saving remains unused or 'unclaimed'; and to promote appropriate national and international action for the utilization of this Unclaimed Wealth." The eleven bulletins contained in this volume, to which Professor T. E. Gregory writes an introduction, were issued at intervals during 1931 and represented a series of reports on the major economic and financial facts that came into prominence in that year.

Insufficient buying and the distinction between saving and investment, subjects which are dealt with in two of the earlier bulletins, are the foundations on which the Committee build their edifice, and if the architecture is frequently unorthodox and daring, the structure is one which cannot be ignored.

In Bulletin No. 4 an attempt is made to estimate the dimensions of Unclaimed Wealth in 1930. Individual calculations are made for wheat, coffee, rubber, coal, crude oil, steel, cotton goods, rayon and motor-cars, and the aggregate of these estimates is used "as a basis for guessing the world's total Unclaimed Wealth." On the basis of average prices in 1927–29 the aggregate for these nine commodities is given as 6,679 million dollars, and the Committee's guess for the world's total Unclaimed Wealth is 15,000 million dollars. An estimate is also given for the losses of producers due to the fall in prices between 1927–29 and 1930 and to curtailed production, the figure here being 18,500 million dollars. While it is acknowledged that these estimates are tentative and even crude, the chief interest centres in the Committee's conclusions drawn from these figures. The total number of unemployed in Europe (excluding Russia), Australia, Canada and the United States at the end of 1930 was of the order of 20 millions. If these unemployed were paid \$750 each per annum to work, then in

a year (i) they could buy Unclaimed Wealth amounting to 15,000 million dollars, (ii) producers could avoid losses estimated at 18,500 million dollars, and (iii) upwards of 15,000 million dollars more wealth could be produced. An estimate is then made of 45,000 million dollars for total savings deposits and hoardings at the end of 1930, and the suggestion is made that this is three times the amount which would be required to employ the 20 million persons for a year. It appears to be assumed that the 15,000 million dollars more wealth produced by the people put into employment would be undoubtedly consumed and that prices would return, at least, to the 1927-29 level. It is unfortunate that no attempt is made to estimate the increase in savings deposits in 1930. Such an estimate would undoubtedly fall very far short of the $33\frac{1}{3}$ per cent. raid on total deposits suggested by the Committee.

In August, 1931, the Committee issued recommendations for budgeting policy to meet the existing situation. As a challenge to the orthodox economist and politician these proposals would be difficult to equal. Briefly, they recommend that the creditor countries adopt emergency measures for twelve months involving (1) reduction of taxation so that the total revenue is reduced by 30 per cent., (2) no reduction in government expenditure, (3) government expenditure in the U.S.A. and France to be increased by the raising of salaries and wages of government employees, (4) budgetary deficits to be met by opening the necessary credits with the central banks at a charge of a half of 1 per cent. per annum. The people benefiting under the reduced taxation or increased salaries and wages are to be "invited" to buy goods and services with the money so placed in their hands.

The examples cited are sufficient to indicate the Committee's tenor of thought, and while few will find themselves in complete agreement with the arguments advanced, there will be few who will fail to derive benefit from the new light thrown on current economic problems. It is significant that many of the views expressed by the Committee in 1931, which received little credence at the time, are now accepted without challenge.

G. R. W.

9.—*Wheat Studies of the Food Research Institute, Stanford University, California; The World Wheat Problem*, Vol. VIII, No. 8, July, 1932. 11" × 8 $\frac{1}{2}$ ". 409-444 pp.

For the past four years the wheat-growers of the world have been faced continuously with a situation in which the available supplies of wheat have been persistently in excess of demand even at abnormally low prices, and now, in the fifth year, there is no indication of material change. This, in brief, is the world wheat problem.

The present publication of the Stanford Research Institute is put forward "as a modest effort" to analyse both the problem itself and the basis for its solution. The nature of the world wheat surplus, how it arose, and why it persists are all dealt with very competently, and the publication is distinguished by its broad general outlook and the "non-political" character of its suggestions

for a solution of the problem. Coming from a responsible American source, it has features of special interest.

In examining the complex mixture of natural, economic and political forces which have been jointly responsible for the rise and persistence of an abnormal wheat surplus since 1928, the chief emphasis is laid on the policies adopted by the majority of Governments, which tend either to restrict consumption or to increase production, or to operate in both directions at the same time. Normally, the marked reduction in prices which has occurred in the world market would have tended both to expand consumption and to decrease production, but Governments, urged by the political necessity of protecting the interests of their farmers, have imposed measures which have either reversed or hindered the operation of the laws of supply and demand. It is pointed out that in recent years two significant tendencies have been observable: first, the tendency to protect producers and thus stimulate production, rather than to stimulate consumption by favouring consumers; and, secondly, the tendency to enhance national self-sufficiency even at heavy cost rather than to reap the advantages of international division of labour. These tendencies have been expressed in various ways, but in one form or another they are to be found operating in every country in the world, and they have been applied with special intensity to wheat production. While this trend persists and separate national policies prolong the world surplus condition, little permanent improvement can be expected, though alleviation of a more or less temporary character may come about by reduced harvests due to natural causes. The remedy, it is suggested, is to be found in a change of outlook, and the writer of the Report is of opinion that "reoriented national policies with consumers the world over more directly in view would probably be more in the interests of farmers themselves than all the direct farm relief measures combined."

Arguments on these lines have often been put forward at the International Conferences which in the last two or three years have attempted unsuccessfully to find a solution to the wheat problem, and it is to be feared that "economic nationalism" in Europe is not yet ready to favour an increase in the consumption of imported wheat at the expense, as it believes, of the interests of its own agriculturists. It is interesting, however, to see that this Report does definitely suggest that a modification of the United States policy in the direction of a freer movement of goods would tend to relieve world depression, and aid, both directly and indirectly, the disposal of the wheat surplus.

R. J. T.

10.—*Statistics Relating to Mortality in the Mercantile Marine*. Report of the London School of Hygiene and Tropical Medicine. London: H.M.S.O., 1932. 9½" × 6¼", 98 pp. 1s. 6d.

The vexed problem of mortality rates in the Mercantile Marine was referred some six years ago to the Permanent Consultative Committee on official Statistics. The Committee's report, which was published under the title of *Statistics relating to Health and*

Mortality in the Mercantile Marine, dealt in considerable detail with the methods which could be used for determining satisfactory death and population data. It was pointed out in the report that such data are only completely available at the time when a Census of Population is taken, since it is only at that time that the number of seamen ashore as well as afloat is enumerated.

The Committee indicated that, for the purpose of compiling the data as to deaths, it was necessary to go both to the records of the Registrars-General and to those of the Registrar-General of Shipping and Seamen. A first attempt in this direction was made by the Registrar-General for England and Wales in his *Decennial Supplement on Occupational Mortality*, issued in 1927, but, as was explained therein, the conclusions arrived at could be accepted only with considerable reserve, due primarily to there being doubt in many cases as to whether the persons dying ashore should properly be regarded as merchant seamen. The Board of Trade accordingly arranged for the data as to deaths on shore to be specially examined for a period of one year, and the report by the London School of Hygiene and Tropical Medicine is based on the data so obtained associated with the similar data relating to deaths at sea. The result was to eliminate from the total deaths 464 out of 3,065 deaths on shore and 242 out of 1,261 deaths at sea, the latter being fishermen and other persons not included within the scope of the annual Census of Seamen.

The troublesome question of the population at risk is hardly dealt with in a manner its importance deserves. Two estimates are given, one of which, by a person other than the author, is critically examined, and if the author had subjected his own estimate to a similar critical analysis he would probably have arrived at a different conclusion. As it is, he abandons both estimates when calculating death rates at ages and by ratings, using instead the number of seamen at sea on the 31st March, 1930. This procedure results in absurdly high death rates, which cannot be compared with those of any other occupation. The author's own estimate of the population at risk yields a crude death rate for ages 20 and over lower than that for males (England and Wales) in 1929 and for ages 20-65 slightly higher than the corresponding rate for males. It is pointed out in the useful summary of conclusions that this result cannot be regarded as furnishing an indication that the Mercantile Marine is a particularly healthy occupation, since the results are affected to a very considerable extent by the age distribution of merchant seamen, which is so different from that of the general population. A comparison of death rates in the Mercantile Marine and Royal Navy has been attempted, with results not unfavourable to the Mercantile Marine, but here again the author is not very happy in his treatment of the comparable populations at risk.

A new classification of deaths has been devised, differing appreciably from that previously used by the Board of Trade in their annual report on deaths on vessels registered in the United Kingdom. In the annual report just issued, the main lines of the new classification have been followed, but modifications have been made in it to

bring it into accord with the short International List. The death statistics in the present book therefore fit with the statistics for neither the preceding nor the succeeding years, a fact much to be regretted.

Owing to the absence of reliable data relating to the population at risk, no attempt has been made to use the method of a standardized population to investigate the mortality for the different age-groups, and the less exact method of proportionate mortality has been resorted to. In this latter method the deaths from a given cause are expressed as a percentage of the total deaths due to all causes, and the proportions so calculated for British merchant seamen in various age-groups are compared, in a table covering 12 pages, with the corresponding proportion for certain shore occupations requiring a high standard of physical fitness. The author reaches the conclusion that, apart from drowning and injury, service in the Mercantile Marine is no more inimical to life and health than are many of the shore occupations frequently regarded as healthful. While the deaths of seamen according to their rating have not been completely analysed, the author finds indications that the proportional frequencies of different diseases vary with rating.

A table classifying all deaths ashore and afloat by ages shows that out of the total of 3,113 deaths of British seamen aged 20 and over, 601 (19·3 per cent.) occurred among seamen aged 75 or over. The corresponding proportion for all males in England and Wales in 1930 was 22·7 per cent. While of the total deaths the proportion which occurred at the age of 65 and over was 39·3 for merchant seamen, it was, in 1921-3, 35·9 for coal miners and 37·8 for railwaymen apart from clerks and signalmen, to take two other industries having a high proportion of accidental deaths. The comparison with coal miners is included in the proportionate mortality tables, but the other comparisons in this paragraph bearing on the healthiness of the Mercantile Marine are not included in the book.

It is to be hoped that the present book will be followed up by a more extended investigation into this subject. A period of one year is far too short on which to base any reliable conclusions, even if there were complete population data with which to relate the death statistics, and it would be more satisfactory if, as is usual in the Registrar-General's occupational mortality tables, the average deaths for three years covering the censal year were related to the population ascertained at the Census.

H. L.

11.—*Banking Policy and the Price Level.* By D. H. Robertson, M.A., Reader in Economics in the University of Cambridge. Third impression, revised. London: P. S. King, 1932. 7½" × 4¾". vii + 103 pp. 5s.

This book was reviewed in the *Journal*, Part IV, 1926, on its first appearance, but it has had so much influence on the development of thought concerning monetary problems that no apology is required for our directing attention to it again. Not because finality has been reached in it, even as revised, for in an introductory note Mr. Robertson says that "the definitions and analyses of

Chapter V." (which deals with the kinds of saving) "were worked out for a society of small entrepreneurs, *i.e.* one in which all incomes are speedily responsive to movements of prices. Reflection and discussion have shown me that they will not stand without modification for a society in which the incomes of most of the factors of production are assumed fixed (or comparatively so), those of entrepreneurs alone being completely mobile." The complexities of modern business are so great and the reactions of monetary factors so intricate, that one must accept all truths as relative; did not Mr. Keynes find his views changing as he wrote his great treatise on *Money*? Still, one would have wished that Mr. Robertson had taken this opportunity of making his book somewhat more complete by adding some suggestions as to the nature of the required modifications. True, that would have made the book more difficult to read, but it is already so Tacitean in style, so stern in its use of "economic jargon," that a little more would scarcely have mattered. The book is not one for the general reader, even if he be a banker, but for those who are prepared to absorb it into their own system of thought as raw material for the production of practical policy.

Mr. Robertson rejects both the "monetary" and "psychological" theories of the trade cycle and shows by a theoretical exposition, subsequently modified by the injection of the typical conditions of modern business, that "we should not expect the appropriate or optimum rate of industrial output to be constant, but to be subject to what may be called 'justifiable' increases and decreases, some at least of which are of a fairly rhythmical nature." After considering the working of money in the economic structure, he concludes that "a policy aiming at ultimate stability of the general price-level seems to be neither the 'most natural' nor the 'most effective' policy for the monetary authority to adopt" in order to secure the greatest stimulus to output.

The analysis in Chapter V of the different kinds of saving and the adoption of new technical terms to define these are perhaps the most important of Mr. Robertson's contributions to theory. A valuable chapter follows on "Short Lacking in the Trade Cycle," *i.e.* saving for the provision of circulating capital. A rise in prices is required "to secure correspondence between the demand for and supply of new Lacking," and it is aggravated by certain natural causes. It is the duty of the banking system to check these secondary price phenomena by changes in its rate of interest and by other methods; it can only provide Short Lacking "by extorting it from the public through the multiplication of currency." Long Lacking for the provision of capital is the business of the investor, but at certain stages the co-operation of the banks is required. The two kinds of saving are complementary, and fixed investment is necessarily discontinuous. "To a large extent, in the writer's view, fluctuations in the desirability of acquiring instruments are the inevitable penalty of industrial progress, but they are also to a certain limited extent attributable to an avoidable lack of responsiveness in the flow of consumable goods required to co-operate with those instruments in the form of real wages." Here we seem to have an approach

to the well-known views of Mr. J. A. Hobson, but Mr. Robertson, instead of proposing to reconstitute incomes, goes on :—" It is part of the duty of the banking system to promote at each phase of the cycle such a balance between the different kinds of production as to minimize this source of instability in the estimates made by the business world of the advantage of acquiring instruments."

At the end of his book Mr. Robertson glances at proposals for remedying industrial depression, examining them from the standpoint of the maintenance of a balance between the production of capital instruments and the production of consumable goods. Passing by "the once equally heretical, but now perhaps over-respectable policy of 'public works,'" he looks with some favour on a proposal which he admits has "formidable difficulties." "If the State," he says, "could, in the later stages of depression and the early stages of industrial recovery, purchase and lay aside considerable stores of half-finished, or even, as its skill grew, of finished, consumable goods, it could promote steadiness not only in the output of these goods themselves, but also in the output of instruments: for by regulating the rate of release of these accumulated stocks it could do something to promote stability in the estimates formed by the business world of the advantage of acquiring instruments, and therefore in the stream of Long Lacking becoming available for embodiment therein." One fears that this combination of "making for stock" and imperiodic "bargain sales" is beyond the present technique of any of the departments of state. Mr. Robertson concludes that "it would almost seem that to act beneficially at every stage of the trade cycle trust magnates, like bankers, would have to become infinitely wise as well as infinitely virtuous." The same is true of "the State" and of any of its organs.

H. W. M.

12.—*Business Forecasting*. By Lewis H. Haney. New York & London: Ginn and Co. 1931. 8½" × 5¼". xiv + 378 pp. 15s.

Those people who believe that over-production is the root of our present evils would probably not be so ready to admit that over-production in the sphere of economic theories of the business cycle is the cause of much of the fog which surrounds this phenomenon. The output of books on business forecasting in America shows no signs of abating, and, unlike the industrialist or agriculturist, the authors and publishers apparently do not have to contend with under-consumption. It is not surprising, in view of the extensive and bewildering display provided by his American colleagues, that the student of business forecasting in this country approaches any new work on the subject with a certain amount of reserve and scepticism, expecting to find much that he has read before, much that is quite contradictory to what he has read before and doubtful of finding anything that is both new and worth while.

Dr. Haney is Director of the Bureau of Business Research of the University of New York, and, in addition to being economic adviser to a number of investment trusts, has done a considerable amount of forecasting for individual industries. His declared aim

in writing the book is "to help lay a basis for scientific business forecasting," and no such object could be attained without covering a great deal of ground which has been traversed many times before. We do not find this disagreeable, for we are taken along in a very efficient high-powered car by a driver who knows his route intimately. As a review of the data available to the business statistician (in his own country) the first 150 pages or so of Dr. Haney's book would be difficult to equal, and the author's estimate of the value of each series of data as an index of business activity bears the stamp of experience and considered judgment. From the point of view of the reader who is not fortunate enough to be an American and have this wealth of data at his disposal, much of this review is, however, only of passive interest. The active interest is awakened when the author begins to discuss his P/V line, of which the book presents for the first time "a complete explanation." Regarding this line Dr. Haney says, "This barometer at least has the merit of having worked successfully throughout the trying period of the last ten years. In so far as I know, it is the only so-called barometer line which has stood that test."

The underlying conception of the " P/V Line" is as follows: Price (P) depends upon the relative force or strength of three factors: (1) demand intensity or lowest effective "demand price" (D_i), (2) supply pressure or supply resistance, the highest effective "supply price" (S_r) and (3) physical volume of supply (V). If we eliminate the effect of the volume factor (V) from prices (P), we have left the relation between D_i and S_r ; in other words, by adjusting a price series for variation in physical volume we arrive at a series which shows the varying relations between the price-determining forces of demand and supply. The P/V line thus enables us to anticipate the trend of the general price level as measured by price indices and to know more certainly in what phase of the business cycle we lie at any given time. After developing the theory of the P/V line, the author illustrates his arguments from the 1922-1924 business cycle, P being represented by Bradstreet's Price Index and V by an index of railway freight tonnage, the latter adjusted for secular and seasonal variation.

Dealing with his *modus operandi*, the author covers for a second time much of the ground which he took us over in the first 150 pages, but this time his foot is on the accelerator, although he does find time to give us a few samples of actual forecasts he has made (and published) in recent years. From general business we pass to forecasting for particular industries, and finally to stock market forecasting.

A word of praise must be given to the admirable diagrams (of which there are fifty). Each diagram is provided with a brief but adequate note summarizing the points brought out by the curves. This is so effective that a great amount of benefit can be derived from the diagrams alone without reference to the text. If at times the author lapses into peculiarities of style, as, for example, on page 280, in describing the construction of an index of consumer purchasing-power—a description which suggests he was writing

a book on cookery or elementary practical chemistry—the book is on the whole very well written, and for the benefit of those not conversant with seasonal variations, long-time trends, etc., an appendix is provided which explains their meaning and calculation.
G. R. W.

13. *-A Century of Public Health in Britain, 1832 1929.* By J. H. Harley Williams, M.D., D.P.H., Medical Commissioner to the National Association for the Prevention of Tuberculosis. With a Foreword by Professor Jameson, Dean of the London School of Hygiene and Tropical Medicine. London: A. & C. Black, 1932. 7 $\frac{3}{4}$ " \times 5". xv + 314 pp. 7s. 6d.

The Foreword tells how "One hundred years ago this country had emerged successful but poverty-stricken from a devastating European war, and entered upon . . . a century of solid sanitary achievement, of which we have good reason to be proud"; and it continues: "It is possible we ourselves are at the beginning of another great chapter in the story of public health progress"; Professor Jameson adds, "This little book, so different from any-text-book of public health, will be read with pleasure and profit by all students of social medicine." There is a striking contrast between the treatment of the earlier and later parts of the century under review; as regards the former our author's point of view stands revealed on p. 288, when he writes, of Francis Galton, "He believed in no creed, escaped in a strange emancipation from the dogmatic prejudices which make Victorian life so amazing to our age." Here we seem to recognize the influence of Lytton Strachey and of one or another "relentless analyst of our social structure," to quote Dr. Harley Williams' phrase on p. 33. But our author has also carefully studied Sir John Simon's *English Sanitary Institutions*, and he gives in Part VII of the book before us short sketches of "The Architects of Social Medicine," who, rather to our surprise (after perusing Parts I and II), turn out to be Florence Nightingale, Simon himself, Chadwick, Galton and Shaftesbury. Even a mid-Victorian reader may be stimulated at this point to take off his hat to Dr. Williams, but the five chapters of Part VII must be carefully read to be fully appreciated. They clearly show that second thoughts are often best; for, to take one instance, Chadwick, who is presented to us (p. 5) as "the arch contriver of this policy," or as some considered the "arch fiend," and (p. 85) as one who only "dimly suggested" the "part played by disease in debasing the individual," is declared (p. 263) to have been "the first man in England who cared anything for the health of the people"; yet, alas! on the very next page it is noted that his programme was one of "icy calm virulence injected into the ageing body of English Local Government." Sir John Simon fares better than Chadwick does; indeed, we are told, "The status for which he struggled is now granted to the Health Officer, public opinion and the legislature itself now listen obediently to his commands"—a pronouncement which goes perhaps just a little beyond the actual facts of the case. Then there follow appreciative accounts, of "that passionate statistician of the finest order" Florence Nightingale, of Francis

Galton, "the prophet and forerunner of all who submit the problems of life to measurement," and of Lord Shaftesbury, whose "social achievement represents the greatest body of reforms that one man has achieved in the last century."

But now passing on to more recent times (in Part III, "The Development of Antituberculosis work in Britain") Dr. Williams' foot is on his native heath, and he gives us a great deal to think about. The statement (p. 136) that "No tuberculosis dispensary in London, nor indeed in England and Wales, was established until 1909," of course means "No tuberculosis dispensary on the Edinburgh model," for reference to Bulstrode's classical report of 1908 (cited on p. 120, where, however, its author appears as Bullstrode), will give the enquiring reader, who turns up Chapter IX, some idea of the provision already existing in 1907, some of it in operation for more than a century prior to that date. Again, the reference (p. 127) to "the statement of Sir Thomas Young, known for his work on astigmatism," may puzzle readers who fail to realize that the great physicist (who is famous for so much else besides his work on astigmatism) is here referred to. An earlier possible source of misunderstanding may be noted, the statement (p. 98) that "Dr. Power admitted that the hypothesis of a contact infection was a tenable one." The aerial convection of small-pox is, of course, here under discussion, and the brief allusion thus parenthetically made to Sir William Power, scarcely does justice to the work of that great pioneer in demonstrating the risks encountered when there were small-pox hospitals in densely populated urban areas. Finally, question may arise regarding the reference to the effect of the "conscience clause" upon "decline of infant vaccination," for in the graph opposite p. 258 the words "Conscientious objection begins" are set against "Vaccination Act 1898," and certain arguments are based thereon. But, of course, the agitation which led to the passing of the 1898 Act grew apace in "the eighties," and was intensified in the early "nineties." Indeed, detailed examination of Dr. Williams' graph (bearing in mind stimulation of vaccination at times of small-pox prevalence in one or other of the big towns, and influences favourable or unfavourable to vaccination of waves of pro- and anti-vaccination propaganda) will demonstrate the fact that the said graph affords a far more precise index of the cause and effect relationships of the several factors at work than even the most ardent student of vaccination statistics might perhaps at first sight have expected to find.

Professor Jameson has told us this book is "so different from any text-book of public health" and is meant for "students of social medicine"; the thoughts of such students, when they read the book, may turn to C. S. Loch, Samuel Barnett, Octavia Hill and other founders of schools of voluntary workers. Dr. Williams, moreover (p. 212), writes, "The newer technique of care work . . . has not been neglected by Education Authorities; and has been well developed in London through voluntary aid. Nearly 6000 workers, most of them specially trained and experienced, follow up the recommendations of the school doctor and see that everything possible is done to carry out the various provisions, clothing and feeding of school

children who require it." On coming to this sentence the various contingents of the great armies of voluntary workers may well follow the example already set by a mid-Victorian reader and express their grateful thanks to Dr. Williams. W. H. H.

14.—*The Social and Economic Aspects of the Drink Problem.* London: Victor Gollancz, Ltd., 1931. 8½" × 5¼"; 180 pp. 5s.

Before the time when there was a prospect of a Royal Commission on the subject, a group of persons (Lord Buckmaster, Lord Balfour of Burleigh, Field-Marshal Lord Methuen, the Hon. Mrs. Alfred Lyttelton, the Right Hon. P. Snowden and Mr. W. L. Hichens) planned an enquiry into the medical, social and economic effects of the consumption of alcohol in Great Britain. Two committees were appointed, one to deal with medical and the other with social and economic data. The conclusions of the first committee have been published in a volume entitled *A Review of the Effects of Alcohol on Man*. The volume under review is the report of the second committee, of which the members were Professor A. L. Bowley, D.Sc., Professor A. M. Carr-Saunders, M.A., Sir James Hamilton, Sir John Mann, Mr. B. Seebohm Rowntree, C.H., Mr. Cecil Rowntree, F.R.C.S., Sir Edgar Sanders and Mr. F. D. Stuart, Honorary Secretary. The committee were directed that their work was to be impartial, and they kept that direction steadily in mind, seeking for actual facts without bias.

The methods of enquiry adopted were directed to the study of (a) drink and industrial efficiency, (b) drink and poverty and (c) drink and crime. For the purposes of (a) personal interviews were held with employers, managers, foremen, shop stewards, doctors, club officials, social workers and others who were familiar with local conditions over lengthy periods. As regards (b) enquiry was made by trained investigators who visited one in each four of 7,381 households in the poorer working-class districts of an industrial city, and investigation was also made into the histories of all recipients of outdoor relief in another city as well as in several poor law institutions elsewhere. For (c) the enquiry took the form of preliminary consultations between the committee's investigators and police officials, court officers and others with special knowledge, followed by a detailed inquiry into police-court cases in three representative industrial areas, an examination of 867 cases of cruelty to children and of the files of a Probation Officer, and an investigation by a medical governor of one of H.M. Prisons into 250 cases of serious crime.

In a chapter discussing some economic aspects of the drink question, instructive graphs are given showing the consumption of and expenditure on beer, wines and spirits respectively in the United Kingdom for a series of years. Other chapters deal with drink and industrial efficiency, the relationship between drink and poverty and drink and crime.

As a result of their enquiry, the committee find that "A large reduction has taken place in recent years in the consumption of alcoholic liquor. Among the more notable aspects of the change are a diminution in heavy drinking, an increasing susceptibility of young people to the influences making for moderation in drinking, and the

elimination of much occupational drinking as the result of mechanical and scientific developments which have modified working conditions creating abnormal thirst and fatigue."

With regard to the question of the effect of drink on industrial efficiency, the committee had to rely upon the practical experience of persons actively engaged as employers, managers or workers, and the evidence seems to suggest that under present conditions drink is not, noticeably and directly at least, "seriously impairing industrial efficiency," and that where there is still any heavy drinking, it is much less noticeable among skilled workers than among labourers and casual workers. Statistical treatment of the material collected by the committee leads them to the conclusion that in the case of 25 to 30 per cent. of the whole of the poverty in a typical working-class district, drink is either a direct or contributory cause. As regards crime, the committee estimate that drink is associated with about 40 per cent. of the more common offences dealt with in the public courts, 25 per cent. of cases of violent crime (murder, manslaughter, etc.) and 15 per cent. of cases of cruelty to children. On the average 50 per cent. of cases of assault and wilful damage are due directly to drink, which also accounts for about 25 per cent. of the matrimonial cases coming before the courts.

An appendix contains particulars of war-time and post-war restrictions on the sale of intoxicants and statistical tables showing production and consumption of alcoholic liquors, materials used in their manufacture, persons employed, etc. J. W. V.

15.—*The Real Meaning of Social Insurance.* By Hugh H. Wolfenden. Toronto: Macmillan Company of Canada, Ltd., 1932. 7½" × 4¾". xiv + 227 pp. \$2.50.

This book is the outcome of a study made by the author for the Canadian Life Insurance Officers' Association. It contains a considerable amount of information about State schemes of insurance adopted in various countries against the risks of accident, unemployment, sickness and old age. The volume begins with a historical review of legislation, and goes on to discuss the causes and extent of dependency, poverty, etc. There follow chapters dealing with the main features of existing State schemes, the financing and cost of such schemes, the problem of medical care and the special problems of unemployment. Another chapter treats of measures, adopted or projected, for dealing with unemployment, other than compulsory State insurance. Of such schemes may be instanced the "Wisconsin Plan," contained in a Bill prepared by Professor Commons of Wisconsin University and introduced (but not adopted) in 1921. The proposal differs in principle from any of the European systems in that (as Professor Commons describes it) "it abandons the idea that the State can operate the system successfully or that the trade unions can operate it . . . the system proposed is exactly like that of the workman's accident compensation law. . . . A mutual insurance company is created, operated and managed solely by the employers . . . [who] establish their own premiums . . . [and] pay out the benefits to the workmen exactly as they pay out the benefits under the accident compensation law. . . .

The system avoids what might be called the socialistic and paternalistic schemes of Europe. . . . It induces the business man to make a profit or avoid a loss by efficient labour management."

Two chapters are devoted to arguments for and against State insurance, and it may be noted in passing that the latter occupy nearly twice as much space as the former. It should be understood, however, that Mr. Wolfenden's book is concerned with the problem as it affects Canada.

In his concluding chapter he points out that "Conditions on this Continent are so very different from those in Great Britain and European countries that it is probable that the administration of national insurance schemes here would be very much more difficult, and would be subject to more dangerous influences, ^{on} elsewhere." Apart from this consideration he is of opinion that ^{the} suggestion that sickness and unemployment insurance schemes ^{provide} suitable remedies for illness and unemployment approaches the problem with the object of relieving their effects instead of preventing ^{of} their occurrence, and thus attacks the question after instead ^{it} before the troubles have arisen." For dealing with sickness he advocates a comprehensive sickness registration plan, periodical health examinations, larger appropriations for Boards of Health, hospitals, sanatoria, etc., a more rational system of medical fees for the community at large, and continued development of voluntary insurance schemes. For unemployment his suggested remedy is of a Utopian character—"international co-operation with a view to the eradication of those world-wide economic maladjustments which so profoundly affect the prosperity of industry and its employees, coupled with 'Unemployment Savings' plans, or even . . . 'Unemployment Insurance' schemes—such plans or schemes, however, to be confined within each industry of every country, and in no sense to be nationally administered."

The chief value of this book to readers in the United Kingdom lies in the historical survey and the chapter describing the principal features of existing State schemes. J. W. V.

16.—*Back to the Coal Standard: the Future of Transport and Power.* By Captain Bernard Acworth, D.S.O., R.N. London: Eyre and Spottiswoode, 1932. 311 pp. 8s. 6d.

Captain Acworth explains the aim of his book in the title. He looks back regretfully to the days when this country relied for its motive power entirely on national resources—coal, water, horses and legs, "and a road accident involving death was a rarity," whereas now "we see a congealing mass of palpitating juggernauts," all in "an atmosphere of choking exhaust fumes." Our author calls himself a free trader, but he objects as strongly as the most convinced protectionist to our reliance on £46½ millions' worth of imported fuel. Having seen much service in ships and submarines, he is especially nervous over the dependence of the Navy on oil fuel obtained from distant sources in foreign countries. Of course the Admiralty, under the late Lord Fisher's guidance, adopted oil because it promised greater speed and more convenience in refuelling and in feeding the

boilers. Captain Acworth has no great belief in speed, and thinks that the best modern coal-firing is little inferior to oil-firing.

Turning to road motor transport, which is the chief consumer of imported fuel, our author takes up the cudgels for the railways, which work on British coal and require no subsidy from the rate-payer. He has no belief in the Diesel locomotive as a cheap engine, and insists that "steam raised by coal is the most economic form of power in Great Britain." He has no use for Lord Weir's main-line electrification; but he prefers the electric tram to the motor omnibus for crowded streets, on the ground that it is both cheaper and safer. The horse, he thinks, holds its own in many spheres, *e.g.* for hauling canal boats at their "economic speed" of three miles an hour, and on the farm. Even in towns the horsed van can compete with the motor lorry, because its first cost and its depreciation are so much lower. Moreover, a horse consumes forty pounds worth of farm products a year.

Aviation is another service which requires a heavy subsidy from the tax-payer. Captain Acworth, with much practical experience of flying, doubts if our civil aircraft concerns have much value as war preparation: he is sure that they cannot carry goods or passengers at a profit. In wartime, air routes are useless without landing-grounds under our own or our allies' control.

Captain Acworth tries to set out fairly the relative advantages of motor-driven, oil-fired and coal-fired ships. In cost of working there is not much difference; but oil undoubtedly avoids the "bother, dirt and expense of coaling ship," and gives a saving of one-third in weight. It is also more easily stowed. For warships, coal bunkers give additional protection. No doubt, experience of coal strikes has had much influence in turning the Navy and part of the Mercantile Marine from coal to oil; Captain Acworth agrees that for a return to coal the nation will require "the loyal and zealous co-operation" of the coal industry as a whole.

Possibly our author is right in criticizing the railway companies for embarking on road transport, and especially for running motor-coaches instead of putting light rail-cars on their branch lines. He wants to remove the present restrictions on railways and electric trams, while he would impose new restrictions on road transport. In particular, he maintains that "heavy, high-speed motor traction transgresses economic law at every point, not only mechanically, but on account of the enormous cost in repairing and maintaining the track which has to bear it." He argues that the transfer of goods and passenger traffic to the railways would mean lower rates and fares. This was the theory of the Railways Act, 1921, but a short-sighted legislature assumed too readily that the railway companies would have no great difficulty in maintaining their net receipts at the pre-war level. This level has never yet been reached, so the rate-and-fare-reducing provisions of the Act have never come into force. No doubt the railways "are carrying a salaries and wages bill which is greater than the business, and, therefore, the country can bear." For the most part this is a carefully argued book; but at times the reader may fancy that he hears the echo of Captain Acworth's election speeches to coalminers in South Wales.

J. E. A.

17.—Other New Publications.*

Edge (P. Granville). Vital Records in the Tropics. (London: Routledge, 1932. 7 $\frac{3}{4}$ " \times 4 $\frac{3}{4}$ ". 167 pp. 7s. 6d.)

[This handbook, by Major Edge, of the London School of Hygiene and Tropical Medicine, is at once a plea for the recognition of the importance of vital statistical records and an attempt to lay down the fundamental rules for their effective compilation in tropical regions. The author insists upon the need for "assembling and analysing *all* facts concerned with the physical well-being of tropical communities," comparing such systematic recording with the book-keeping universally regarded as essential for the assessment of results and the determination of policy in the world of business. He very properly emphasizes the prime importance of sound data, and the necessity for an at least approximately accurate population census as the basis of all vital statistics. The difficulties of obtaining correct information in respect of primitive peoples are interestingly discussed and ingenious suggestions are made for overcoming the obstacles arising out of ignorance and superstition. Major Edge is no less helpful on the technical side; he provides specimen schedules, beginning with the most elementary forms, shows methods of tabulation and graphical illustration, and indicates the various uses of the statistics, with adequate warnings as to the dangers to be avoided in drawing deductions from the assembled figures. Each chapter is followed by a short bibliography. The book, though explicitly confined to the elements of the subject, should save medical officers and administrators unaccustomed to statistical work from the loss of time entailed in buying their experience first hand. More care, however, might have been given to the correction of proofs; "morality" for "mortality" is an unfortunate and by no means the sole misprint; while superfluous commas frequently obscure the sense.]

George (Henry). The Science of Political Economy. New edition. London: The Henry George Foundation, 1932. 7 $\frac{1}{4}$ " \times 4 $\frac{1}{2}$ ". xiii + 433 pp. 2s. 6d.

[This work, begun in 1891 and published posthumously in 1898, has been republished by the Henry George Foundation in a new cheap edition. The original index has been revised, rearranged, and enlarged.]

Haristoy (Just). L'Epargne des Travailleurs: la spéculation et le néo-capitalisme aux États-Unis. Paris: M. Giard, 1932. 8 $\frac{1}{4}$ " \times 5 $\frac{1}{2}$ ". 427 pp. 60 frs.

[The author plainly states that his purpose is to counteract the advocacy, by Americans visiting Europe, of the system of "neo-capitalism," or the salvation of industry by "employee stock ownership," i.e. participation by workers in the undertaking in which they are employed. Dr. Haristoy's investigations into the system, as exhibited in the United States during the developments of the war and post-war periods, led him to the definite conclusion that any advantages accruing to the workers through such participation were heavily outweighed by the inherent disadvantages, and in any case were confined to times of prosperity, while the insecurity of both income and capital and the temptation to speculate must be permanent drawbacks. In his view the advocates of the system were inclined to minimize the risks to the workers' savings in the effort to divert their interests to the side of capital and at the same time to attract additional capital to the undertaking, and the whole theory of neo-capitalism is founded on illusion. In order that readers may judge for themselves the results of his examination are fully set out. The examination appears to have been thorough: the preface of the book contains a long list of the industrial chiefs and statisticians who gave him their views, their experience, and

* See also "Additions to Library," pp. 185 *et seq.*

their figures; the introduction summarizes the author's conclusions, and the book proper consists of their detailed justification. Part I, *Workers' Savings and Speculation*, examines the technique of investment by employees, the comparative merits of various classes of holdings, the practice of different undertakings with respect to allotment, payment, etc., the arguments advanced in favour of the system, the conditions necessary for its effective functioning, the risks attached, and the lessons, in relation to this subject, of the financial crisis of 1929. Part II is concerned with the theory of neo-capitalism, and the facts adduced as evidence of its existence and efficacy are confronted with statistical data and found to be capable of other interpretations. An appendix consists of the respective schemes for workers' investment of the American Telephone and Telegraph Company, the United States Steel Corporation, the Standard Oil Company, and the International Harvester Company.]

Huber (Michel). *La Population de la France pendant la Guerre, avec un appendice sur les revenus avant et après la guerre*. Paris : Presses Universitaires de France; London : University Press, 1932. 10" × 6½". 1028 pp. 35s.

[This study, which belongs to the series issued by the Carnegie Endowment for International Peace, is an elaborate investigation of the effect of the war on the present and future population of France. In the first section the author describes the demographical position in the period immediately preceding the war, when the population was almost stationary, owing to the combination of a low birth-rate and a relatively high death-rate. He emphasizes the fact that notwithstanding the migration to the towns, which in France, as elsewhere in Western Europe, was a consequence of industrial expansion, about half the inhabitants were still engaged in rural occupations at the outbreak of war. The major portion of the book is, naturally, devoted to an examination of the disturbances caused by the war. The displacements due to mobilization and invasion, the losses by death and disablement, sickness and capture, together with the numbers of dependents affected thereby, and the ultimate demographical consequences, are the subject of careful calculation. The third part deals with the modification of these results owing to the readjustments of the post-war period: demobilization, the return of prisoners of war and interned civilians, and the absorption of the provinces of Alsace and Lorraine. A comparison of the results of the censuses of 1911 and 1921 shows a decrease of over 2½ million inhabitants in the pre-war area of France, and the effect on the future trend of the population is discussed. The appendix compares the national income in the years 1920 to 1928 with that of 1913. The book contains a number of diagrams, a full bibliography, and an adequate index.]

League of Nations. Economic Committee. *The Timber Problem*. Geneva, 1932. 10½" × 8". 51 pp. 1s. 6d.

[This document contains the Report of the Delegation of the Economic Committee, a brief statement of the timber situation in various countries, and certain statistics of the exports of timber from nine European countries for the years 1925 to 1931. The Committee were requested to examine the world situation in relation to timber production and trade and to consider whether any action on international lines would be desirable. They found that up to 1929-30 the trade was satisfactory and that the subsequent acute decline was mainly attributable to the general economic depression. They were of opinion that no remedy could be effective unless it was international in scope, and they put forward some suggestions for the League's consideration.]

McBain (A. G.). Complete Practical Income Tax. 6th ed. (including the provisions of the Finance Act, 1932). London: Gee & Co., 1932. $5\frac{1}{2}'' \times 8\frac{1}{2}''$. xi + 295 pp. 7s. 6d.

[The earlier editions of Mr. McBain's useful book have been noticed in the *Journal*. The present edition has been brought up to date in accordance with the Finance Act, 1932, and with recent Case Law or Inland Revenue decisions. The book is well indexed.]

Sheffield Social Survey Committee. Survey Pamphlets. No. 1. A report on a survey of the milk supply of Sheffield. By *A. J. Allaway*. 1931. 36 pp. 6d. No. 2. A report on the housing problem in Sheffield. By *A. D. K. Owen*. 1931. 68 pp. 6d. No. 3. A report on a survey of licensing in Sheffield. By *J. N. Reedman*. 1931. 40 pp. 6d. No. 4. A report on unemployment in Sheffield. By *A. D. K. Owen*. 1932. 74 pp. 1s. No. 5. A report on the development of adult education in Sheffield. By *G. P. Jones*. 1932. 38 pp. 6d. Sheffield: The Committee, 84, West Street. $8\frac{1}{2}'' \times 5\frac{1}{4}''$.

[The Sheffield Social Survey Committee was formed in 1928 "for the purpose of undertaking a comprehensive survey of the social life of Sheffield in all its aspects, its development in the past as well as its present condition." The Chairman is Professor Douglas Knoop. Numerous enquiries have been undertaken by the Committee; in addition to the five reports named above the results of two of their investigations have been published by other bodies: A Survey of Children's Cinema Matinees (Sheffield Council of Social Service), and a special investigation undertaken for the Royal Commission on Unemployment Insurance (H.M. Stationery Office). The Committee hope shortly to issue reports on Juvenile Employment and Welfare, Public Health, Transport, Standard of Living, and Library Services.]

Spalding (W. F.). Foreign Exchange and Foreign Bills in Theory and Practice. 8th ed. London: Pitman, 1932. $8\frac{1}{2}'' \times 5\frac{1}{4}''$. 333 pp. 7s. 6d.

[New editions of this book are issued frequently enough to ensure that the information is kept well up-to-date. In this, the eighth, several portions have been rewritten and new matter has been added, in order to bring it abreast of the changes in the international financial situation which have occurred since the publication of the seventh, in 1928. The lack of conciseness and clearness in presentation commented on in the *Journal* review (Vol. LXXIX., p. 346) unfortunately persists through the successive issues and tends to diminish the gratitude which should be due to the provider of so large a mass of solid information.]

Weston (W. J.). Banking and Currency. 3rd ed. London: University Tutorial Press, 1932. $7\frac{1}{4}'' \times 4\frac{3}{4}''$. 295 pp. 6s. 6d.

[This book is a good example of its kind. It is a text-book prepared by the head of the School of Commerce, the Polytechnic, London, for students reading for examinations, and, in parts at least, appears to have been compiled from notes prepared for correspondence classes. It is clearly written and reasonably comprehensive and up-to-date, the chief monetary events of recent years up to the end of 1932 being included. The sections on index-numbers are not very satisfactory; neither their qualities nor their deficiencies are made clear. It would also have been useful to the student if more details had been given of the functions of the merchant bankers and the discount houses and of the manner in which the demand for capital for home purposes is supplied. There are many interesting quotations which lighten up the book, and precise reference to their origin should have been made.

CURRENT NOTES.

On another page we give our usual table summarizing the overseas trade of the United Kingdom for the years 1931 and 1932. The value of the total imports during last year amounted to £703,133,000, a decrease of 18·4 per cent. on the corresponding total for 1931. British exports were valued at £365,138,000, showing a decrease of 6·5 per cent., while exports of imported merchandise were valued at £50,914,000, a decline of 20·3 per cent. The real decline in the re-export trade was probably considerably smaller than would appear from these figures, since, resulting from the increased proportion of the imports now dutiable, there was a substantial increase from £19,207,000 to £22,596,000 in the value of goods transhipped under bond, which are not included among the imports and re-exports. Adding in the value of the goods transhipped under bond, the decrease in the value of the re-exports is reduced to 11·5 per cent. To a considerable extent these decreases were due to the fall in prices of imports and exports which has continued almost unchecked in spite of the departure from the gold standard in September, 1931; but imports, especially of manufactured articles, have been restricted as a result of the new import duties imposed during the year. As regards British exports, the calculations made by the Board of Trade show that, eliminating price changes, such exports were very slightly larger in volume in 1932 than in 1931, notwithstanding the quota and exchange restrictions in force in so many countries.

In regard to food-stuffs, while the value of the retained imports declined by £36,825,000 or 10 per cent., the imports of many descriptions were maintained at the high level reached in 1931, and in some cases, notably bacon, butter, tea, sugar, apples and bananas, retained imports attained record dimensions last year. The increase in bacon compared with 1931 was about 4 per cent. In respect of beef and mutton and lamb there were declines of about 6 and 2 per cent. respectively, from the very high figures recorded for 1931. Retained imports of cereals also showed some decline from the 1931 totals, the decline in the case of wheat being 12 per cent., while in respect of wheat-meal and flour imports were smaller than in any year since 1925. Imports of wheat from Canada and Australia were higher than in any earlier year, and there was also a record importation of flour from Australia. In respect of a number of food products, including

Movements and Classes.	Twelve Months ended 31st Dec., 1931.	Twelve Months ended 31st Dec., 1932.	Increase (+) or Decrease (-).			
Imports, c.i.f.—	£'000.	£'000.	£'000.			
Food, drink, and tobacco	416,722	374,680	(-) 42,042			
Raw materials and articles mainly un- manufactured	173,038	164,462	(-) 8,576			
Articles wholly or mainly manufac- tured	261,719	157,676	(-) 104,043			
Other articles	9,774	6,315	(-) 3,459			
Total Imports ...	861,253	703,133	(-) 158,120			
Exports, f.o.b.—						
<i>United Kingdom Produce and Manufactures—</i>						
Food, drink, and tobacco	35,522	32,328	(-) 3,194			
Raw materials and articles mainly un- manufactured	47,040	43,626	(-) 3,414			
Articles wholly or mainly manufac- tured	292,029	275,602	(-) 16,427			
Other articles	16,031	13,582	(-) 2,449			
<i>Imported Merchandise—</i>						
Food, drink, and tobacco	20,143	15,182	(-) 4,961			
Raw materials and articles mainly un- manufactured	25,710	23,612	(-) 2,098			
Articles wholly or mainly manufac- tured	17,411	11,802	(-) 5,609			
Other articles	604	318	(-) 286			
Total Exports ...	454,490	416,052	(-) 38,438			
Bullion and Specie—						
Imports	106,708	160,049	(+) 53,341			
Exports	139,680	140,268	(+) 588			
Movements of Shipping in the Foreign Trade—	Number of Vessels.	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.
<i>Entered with cargoes—</i>						
British	29,238	38,195	24,846	35,511	(-) 4,392	(-) 2,684
Foreign	25,770	22,080	22,733	20,549	(-) 3,037	(-) 1,531
Total entered ...	55,008	60,275	47,579	56,060	(-) 7,429	(-) 4,215
<i>Cleared with cargoes—</i>						
British	35,691	38,165	32,138	34,850	(-) 3,553	(-) 3,315
Foreign	19,710	20,175	18,789	18,540	(-) 921	(-) 1,635
Total cleared ...	55,401	58,340	50,927	53,390	(-) 4,474	(-) 4,950

those just mentioned, it is found that imports from the Dominions have increased to a considerable extent at the expense of imports from outside the Empire, some of these being goods on which there is now a duty on importation from foreign countries, but not from the Empire (except the Irish Free State), and others being goods on the free list. Though imports of tea were larger than in any previous year, the increased quantities went into stock and the estimated home consumption was somewhat less than in 1931; the amount of sugar entered for home consumption was, however, larger last year than ever before.

Apart from February, when there were large imports of goods in anticipation of the 10 per cent. duty imposed on 1st March, retained imports of manufactured articles in 1932 have remained very constant in value, the monthly figures varying only between £10,000,000 and £12,000,000. For the year as a whole retained imports were valued at £145,873,000 as compared with £244,308,000 in 1931. The restrictive effect of the new duties was very marked in the textile and apparel groups, and taking these in the aggregate there was a reduction in retained imports from £60.9 million in 1931 to £21.2 million last year. Imports of cotton piece goods declined in quantity by 83 per cent., woollen and worsted yarns by 95 per cent., woollen and worsted tissues by 85 per cent., carpets of wool by 64 per cent., and tissues of artificial silk mixed with other materials by 62 per cent. An important exception to the general decline was the increase from 1,791 to 1,822 million gallons in retained imports of refined petroleum, there being a record quantity of motor spirit imported and retained, while imports of fuel oil were only exceeded by those in 1921.

The reduction in imports of manufactured articles has necessarily led to an increase in the imports of raw materials from which to manufacture articles to replace those formerly imported, the demand for such manufactured articles having fallen off only to a very limited extent, judging by the published retail trade figures. Retained imports of raw cotton were higher than in either 1930 or 1931, increasing by 1.5 million lbs. (14 per cent.) in relation to the later year, while those of sheep's and lambs' wool, which have shown an increasing tendency for many years, increased by 3 per cent. to 602 million lbs., following an increase of 18 per cent. the previous year. Other raw materials showing substantial increases were silk, phosphate of lime, and palm kernels; while retained imports of copra and chemical and mechanical wood pulp were larger than in any previous year, those of linseed and of wet hides were larger than in any year since 1924, and those of flax and tow larger than in any year since 1923. Retained imports of hemp and jute were, on the other hand, smaller than in

most previous years. The value of retained imports of raw materials in 1932 was £140,850,000, showing a reduction of £6,478,000 as compared with 1931. The volume of such imports was, however, 2 per cent. greater than in 1931.

The quantity of coal exported last year was 38,899,000 tons, being 3,850,000 tons less than in 1931; the value in the two years constituted 8·7 and 8·9 per cent. respectively of the total value of British exports. There was also a fall from 14,610,000 tons to 14,183,000 tons in the shipments of bunker coal for the use of steamers in the foreign trade and fishing vessels. A small further decline was recorded in the tonnage of iron and steel exported, this being 1,889,000 tons in 1932 and 1,979,000 tons in 1931, and comparing with 4,380,000 tons in 1929. The Board of Trade have calculated that adding together the value of the exports of iron and steel and manufactures thereof, "iron ore and scrap, cutlery, hardware, tools, machinery, and vehicles (except rubber tyres), the contribution to the total value of British exports was 19·1 per cent. in 1924, 26·3 per cent. in 1930, 23·9 per cent. in 1931 and 21·6 per cent. last year." That exports of iron and steel have declined relative to the other items mentioned above is shown by a comparison of the above proportions with those recorded for iron and steel alone, viz. 9·3, 9·0, 7·8 and 7·7 per cent. for the four years respectively. In this connection the marked increase in exports of motor-cars last year may be noted, the number of cars and chassis exported being 40,424 as compared with 24,642 in 1931 and a record of 42,011 in 1929. Exports in November and again in December last year were higher than in any previous month. Exports of machinery declined from 329,300 tons in 1931 to 301,800, but there were considerable increases in respect of textile machinery, machine tools and sugar-making and refining machinery. The value of the exports of cutlery, hardware, implements and instruments was higher than in 1931.

It is further stated in the *Board of Trade Journal* (January 19, 1933), that "in 1924 textile exports formed 38·9 per cent. of the total value of British exports, but this proportion had declined in recent years, being 26·5 per cent. in 1930 and 25·5 per cent. in 1931; last year, however, there was an increase to 28·8 per cent. Cotton exports, which formed 25·1 per cent. of the total in 1924, fell from 15·4 per cent. in 1930 to 14·6 per cent. in 1931, but a rise to 17·3 per cent. was shown for last year. Exports of wool and manufactures thereof, which were 7·3 per cent. for 1930 and 1931, last year formed a slightly

increased proportion (7·5 per cent.) of the total, this being, however, much lower than in 1924 (10 per cent).” Exports of practically all the principal descriptions of cotton goods were larger last year than in 1931, exports of cotton yarns increasing from 133·5 to 141·7 million lbs. and of piece goods from 1,716 to 2,198 million square yards, and the value of the total exports was £6½ million higher than in the previous year. Exports of piece goods to India amounted to 599 million square yards last year, 390 million in 1931 and 778 million in 1930. Exports to all leading markets except Switzerland were greater last year than in 1931, the decline in the case of Switzerland being probably due to a decrease in the goods sent abroad for finishing. There was a remarkable increase in exports of wool tops, from 28·0 to 41·8 million lbs., a figure only exceeded by that for 1927. Woollen and worsted tissues were an important exception to the fairly general increase in exports of textile manufactures.

Among other goods, the value of the exports of chemicals, drugs, dyes and colours increased by £360,000 and that of paper and cardboard by £185,000, the increase in the former group being mainly in respect of sodium compounds, coal-tar products and zinc oxide, and in the latter in respect of newsprint. Exports of non-ferrous metals were substantially maintained, but there was a considerable decline in exports of pottery and in electrical goods and apparatus.

The year ended with a relatively good month for exports, the value, £32,445,000, being higher than in any month of the year except April, and being £368,000 more than in December, 1931.

The excess of imports over exports of merchandise, which was £386,385,000 in 1930, increased to £406,763,000 in 1931, but last year declined by nearly £120 million to £287,081,000. Movements of bullion and specie attained record dimensions last year, but were smaller on the export side than in 1931 when allowance is made for the enhanced value of gold in terms of sterling. Imports amounted to £160,049,000 and exports to £140,268,000, showing a net influx of £19·8 million. In 1931 there was a net export of £33·0 million. These movements have been influenced by other causes than merchandise trade, and imports and exports of gold cannot, therefore, be added directly to imports and exports of merchandise to arrive at a visible “balance of trade.” The very large movement of gold last year may be traced to the enhanced value of gold in terms of rupees leading to the release from India of some £56,000,000 of the gold which had been accumulating in that country over a long period of time, such gold coming here and being passed on, mainly to France.

The calculations regarding the volume and value of our overseas trade in the *Board of Trade Journal* for January 26 show the variations in the quantities of goods imported and exported, eliminating the effect of price changes. Average values for the first three quarters of the year continued the fall which had been in progress since the autumn of 1929, but for the last quarter the fall was checked and in the case of imports there was an increase of between 2 and 3 per cent. This rise may, perhaps, be attributed to (1) the lower exchange value of the £ sterling during the last quarter of the year and (2) the rise in prices which occurred from July to September. Retained imports showed the following changes in volume compared with a year earlier: —Food, drink and tobacco, — 3·2 per cent; Raw materials, + 2·1 per cent; Manufactured goods, — 35·9 per cent; All articles, — 12·0 per cent. The volume of British exports was 0·4 per cent. greater than in 1931, manufactured goods showing an increase of 2·8 per cent. and raw materials a decrease of 5·6 per cent. Practically the whole of the decrease in respect of raw materials was due to coal, which decreased by 7 per cent., while other raw materials in the aggregate showed only a small decrease in the volume of exports.

Over the year 1932 *wholesale prices* as measured by the Board of Trade index-numbers showed a fall of about 2·4 per cent. The decline in the general price level was practically continuous for the first seven months of the year, but there was some arrest of the fall during August and September. Before the end of the latter month, however, prices fell away again slightly, and at the end of the year the index-number showed a decline of 4·6 per cent. compared with December, 1931. The increase in general prices is now only 2·4 per cent. above those ruling when the gold standard ceased to govern currency issues in September, 1931, the group embracing articles of food showing indeed a slight fall and that covering other articles a rise of about 3·7 per cent. It is to be noted, however, that the index-number for all articles other than food in December, 1932, was 6 per cent. above that for June, 1932.

As compared with 1931 the only noticeable changes were in the cereals group, which showed a rise of 7·8 per cent., and in the meat and fish group and in wool, which showed declines of 8·8 per cent. and 9·7 per cent. respectively. There was a slight decline in the level of the iron and steel group, but at the end of the year tinplates showed an advance in price over December, 1931, of 15·6 per cent., and steel galvanized corrugated sheets of 25 per cent. As compared with December, 1931, tin and spelter showed advances in December, 1932, of 10 per cent. and 6 per cent. respectively, while copper and

lead each fell about 23 per cent. The poor potato crop of 1931 kept prices very high during the first half of 1932, but at the end of the year prices were not much more than half of those prevailing in December, 1931.

The index-numbers since June, 1932, are given below.

Averages for 1930 = 100.

Period.	Total Food.	Total not Food.	All Articles.
July, 1932	85.3	80.0	81.8
August, 1932	84.7	82.7	83.3
September, 1932	84.8	85.8	85.4
October, 1932	83.6	85.2	84.6
November, 1932	84.1	84.9	84.6
December, 1932	85.1	84.3	84.5
Year 1932	87.3	83.8	85.1
„ 1931	88.0	86.7	87.2

As compared with 1913 the general level of wholesale prices shows an advance of only 1.6 per cent., the coal and miscellaneous food groups showing advances of 23.3 per cent. and 28.9 per cent. respectively, while smaller advances are shown by the iron and steel (3.7 per cent.) and meat and fish groups (5.7 per cent.)

As until recently the Board of Trade index-number was given on the basis of average prices in 1924, the index-numbers on this basis for the last four years are printed for reference.

	Total Food.	Total not Food.	All Articles.
1929	87.4	79.4	82.1
1930	76.1	69.6	71.9
1931	67.2	60.3	62.6
1932	66.5	58.4	61.1

The *Economist* index-number, which during the arrest of the fall in prices in July–September, 1932, indicated a more marked rise in the general level than was apparent in the Board of Trade index-number, has declined steadily since the beginning of September, when it stood at 64.7 (1927 = 100). At December 28, 1932, it was 61.1, or 5.5 per cent. below the figure for September 7, and 5.9 per cent. below that for December 3, 1931.

As measured by the *Statist* index-number the general fall of prices in 1932 was 2.9 per cent., but as between the end of 1931 and 1932 a fall of about 9 per cent. is indicated. This latter was due chiefly to a decline of over 20 per cent. in the prices of the vegetable food group and of nearly 17 per cent. in the prices of sugar, tea and coffee,

prices of all food-stuffs together registering a decline of over 13 per cent. Since August, 1932, when the general index-number (1866-77 = 100) stood at 80.7, there has been a fairly steady decline to 77.7 at the end of December, 1932, or roughly 3.7 per cent. The position of the British index-numbers is compared below with those of the gold-standard countries.

	Board of Trade (1930 = 100).	<i>Economist</i> (1927 = 100).	<i>Statist</i> (1866-77 = 100).	U.S.A. (Bradstreet) (1913 = 100).	France (Stat. Gen.) (1913 = 100).	Germany (Stat. Reichsamt) (1913 = 100).
August, 1932	83.3	61.9	80.7	77.9	394	95.4
December, 1932 ...	84.5	61.1	77.7	74.7 *	390	—

* November, 1932.

The improvement in the shipping freights which took place during the last three months of 1931 was not maintained during the first half of 1932, and by July, 1932, the index-number compiled by the Chamber of Shipping, which in December, 1931, was 21.15 (1920 = 100), had fallen to 16.68, or over 21 per cent. Freights have risen, however, since the summer months, and in December, 1932, were nearly 18 per cent. higher than in July, but the figure for December (19.69) is still nearly 7 per cent. below that for a year ago. More hopeful prospects are indicated, however, by a slightly increased demand for ships on a time charter basis, and the general outlook for tramp shipping is reported to show some improvement.

The fluctuations in the *value of securities*, which on the whole were in a downward direction during 1931, showed on balance an upward movement during 1932. The index-numbers of Stock Exchange Values published monthly in the *Bankers' Magazine* represent an increase of 11.2 per cent. at December, 1932, over the figure for December, 1931. The appreciation was greatest in the fixed interest stocks (13.5 per cent.) as compared with a depreciation of 9.2 per cent. between December, 1930 and December, 1931. In variable dividend securities the appreciation was only 5.6 per cent. as compared with a depreciation of 23.5 per cent. over the previous twelve months. There was some arrest of the improvement in values during the months April-June and again in November and December; but at the latter date the index-number for fixed interest securities stood higher at 116.1 (December, 1921 = 100) than in any month since April, 1923 with the exception of September and October, 1932, when the number stood at 118.4 and 120.3 respec-

tively. As regards the variable dividend securities the index-number stood at 78.9 in June, 1932, the lowest figure recorded since the start of the index-number, and though there has been a fairly steady appreciation since that date, and the price at December was higher, as has been stated above, than in December, 1931, the mean of the index-numbers for the year was lower than in 1931 and indeed for any earlier year. The index-numbers for the period July to December, 1932, are given below.

	Fixed Interest Stocks.	Variable Dividend Securities.	Total.
July, 1932	115.6	84.5	105.5
August, 1932	116.1	92.5	108.4
September, 1932	118.4	96.8	111.4
October, 1932	120.3	96.3	112.5
November, 1932	115.9	96.8	109.6
December, 1932	116.1	95.8	109.4
December, 1931	102.2	90.7	98.5
December, 1930	112.5	118.5	114.4

The continued depression in trade and industry is no doubt responsible for the low price of the variable securities and the abundance of money at cheap rates for the improved value of the fixed interest stocks.

Between 1st January and 31st December, 1932, the general level of *retail prices* in Great Britain of articles of working-class consumption, as measured by the Ministry of Labour index-number, fell 3.4 per cent., and at the latter date were 42 per cent. above the level of July, 1914. There was a decline in the prices of food during the year of 6.1 per cent., and rents showed a very slight upward movement. There was a fall of about 2.6 per cent. in the cost of clothing and of about 1.4 per cent. in both the cost of fuel and light and of other miscellaneous articles of consumption. Food prices, which had shown a fairly general fall up to September, rose rather more than 1½ per cent. between September and December, but at the end of the year a slight decline was again indicated. The index-numbers since July, 1932 (July 1914 = 100) are given below.

	Aug. 1932.	Sept. 1932.	Oct. 1932.	Nov. 1932.	Dec. 1st, 1932.	Dec. 31st, 1932.
Food prices	123	123	125	125	125	123
All items (food, clothing, rent, fuel, etc.)	141	141	143	143	143	142
<i>All items (a year earlier) ...</i>	<i>145</i>	<i>145</i>	<i>145</i>	<i>146</i>	<i>148</i>	<i>147</i>

The mean of the index-numbers for 1932 was 143·6 (July, 1914 = 100) compared with 147·5 in 1931 and 158 in 1930. It was lower than in any year since 1915, when it was 123.

Returns relating to *retail sales* appear monthly in the *Board of Trade Journal*. They are prepared by the Independent Association of Retail Distributors in conjunction with the Bank of England and show the relation of the sales of each month to those of the corresponding month a year ago; figures are cumulative throughout the year. Separate figures are given for food and ten other kinds of merchandise, and the returns are given under five districts. In the latest return, that for December, 1932, the total retail sales of all merchandise for the eleven months February to December, 1932, showed a decline of 4·0 per cent. on the sales for the corresponding eleven months of 1931. Sales of food and perishables showed a fall of 3·2 per cent., and those of other articles of 4·8 per cent. In Central and West London the fall was 4·0 per cent., and in Suburban London 3·2 per cent. Over the period February, 1931, to January, 1932, the fall had been 4·9 per cent. compared with the preceding twelve months (food 5·2 per cent., not food 4·5 per cent), and the decline in sales over the two years does not disclose much drop in consumption, bearing in mind the fall in retail prices during the period.

The table gives for the principal Overseas Dominions and foreign countries the percentage increases at July, 1932, and on the latest available date of the retail prices of food and other items compared with the prices at or about July, 1914.

The average level of wage-rates declined in 1932, but not quite to the same extent as in 1931. In the industries for which statistics are available,* the estimated net weekly decrease in rates of wages of the persons affected amounted to about £248,000 (decreases £250,800, increases £2,550) as compared with £401,000 (decreases £406,300, increases £5,100) in 1931. The principal trades affected were cotton-spinning and manufacturing, the building trades, and the transport and public administration services. In the cotton trade the reductions off current wages amounted to 7 $\frac{3}{4}$ per cent. and 8 $\frac{1}{2}$ per cent. in the spinning and manufacturing sections respectively. In the building trades there was a fairly general reduction throughout Great Britain of $\frac{1}{4}$ d. per hour for skilled workmen and of from $\frac{1}{4}$ d. to $\frac{1}{2}$ d. per hour for labourers. Dock labourers at most ports suffered a reduction of 10d. per day and corporation tramway and omnibus employees in most districts outside the Metropolitan area a reduction of from $\frac{3}{4}$ d. to $\frac{1}{2}$ d. per hour for those earning over 47s. 6d. per week.

* The statistics are exclusive of changes affecting agricultural labourers, Government employees, domestic servants, shop assistants and clerks.

It is estimated that the average decrease for all industries combined (including agriculture) was equivalent to nearly 2 per cent. of the wage rates in operation at the beginning of the year.

	Retail Prices of Food at		Retail Prices of All Items at		Date of Latest Return (1932).
	July, 1932.	Latest date available.	July, 1932.	Latest date available.	
	Per cent.	Per cent.	Per cent.	Per cent.	
Great Britain	25	23	—	—	Dec. 31
<i>Overseas Dominions.</i>					
Australia	23	22 *	—	22	2nd Qr.
Canada	— 8	— 3	25	25	Nov.
Irish Free State	34	35 †	53 †	55	Nov.
New Zealand	8	6	31 †	29	Nov.
South Africa	— 6	— 7	17	16	Oct.
<i>Foreign Countries.</i>					
Belgium	—	—	608	626	Nov.
Czechoslovakia	9	8	2	4	Nov.
Denmark	15	19	54	56	Oct.
Egypt (Cairo)	8 ‡	10 ‡	28	30	Oct.
Finland	756	793	894	915	Nov.
France (Paris)	443	436	417 §	417 §	Dec.
Germany	14	19	22	18	Dec.
Italy	318	319	—	276 ||	Nov.
Norway	34	34	49	49	Nov.
Spain	79	84	—	—	Oct.
Sweden	28	25	56	54	Dec.
Switzerland	24	22	38	35	Nov.
United States	— 1	— 2	36 ¶	36 ¶	Oct.

* September, 1932. † Figure for August, 1932. ‡ Includes fuel and light. § Figure for third quarter, 1932. || January–June, 1932. ¶ June, 1932.

There was very little change in *hours of labour* in 1932, the total number of workpeople affected by such changes being only 9,600, of whom 6,000 had an average increase of $2\frac{2}{3}$ hours per week, and the remainder a decrease of about $1\frac{1}{2}$ hours. Apart from those among coal-miners in 1926, 1930 and 1931, and among building trade operatives in 1922 and 1923, there have been few changes in hours of labour since the widespread reductions in working hours in 1919 and 1920.

The total number of workpeople involved in 1932 in *trade disputes* beginning in that year was 337,000, and in addition about 41,000 were thrown out of work at establishments where the disputes occurred but were not themselves parties to the disputes. The aggregate time lost owing to disputes was about 6,500,000 working days, or about 500,000 days less than in 1931. More than 75 per

cent. of the numbers involved and over 85 per cent. of the working days lost were due to the disputes in the spinning and manufacturing sections of the cotton industry in September and October. The years of general coal-mining disputes, 1912, 1921 and 1926 were and will probably long remain those in which the largest number of working days were lost owing to disputes. In these years the working days lost amounted to 41 millions, 80 millions and 162 millions respectively.

Unemployment remained acute throughout Great Britain and Northern Ireland during the whole of 1932, and was on the whole worse than in 1931, when unemployment was more severe than in any previous year. Apart from a slight reaction in March and April, the rate of unemployment in the insured trades did not fall below 22·0 per cent. until October and December, when rates of 21·9 and 21·7 were recorded. The decline in the rate in December is due no doubt to the usual increase in employment for the Christmas trade, which is almost always succeeded by a seasonal reaction in the month of January. Employment was at its worst at the end of August, when the percentage unemployed in the insured trades reached 23·0 per cent. and the numbers (insured and uninsured) registered at the Employment Exchanges reached the very high total of 2,936,000. Since that month the numbers registered have fallen to 2,796,000, but they are still 222,000 higher than at the end of 1931. Moreover, some addition has to be made to the figures of unemployment for 1932 owing to the administrative changes in unemployment insurance commencing at the end of 1931 and to certain changes in the method of registering unemployment among dock-workers.

Apart from some appreciable improvement in the cotton trade, in the artificial silk trade, and in the motor and cycle branches of the engineering trade, there was slight improvement to be noted, while the heavy industries continued in their great state of depression.

The monthly percentages throughout 1932 are as follows for Great Britain and Northern Ireland :—

Jan.	...	...	22·4	May	...	...	22·1	Sept.	...	...	22·8
Feb.	...	...	22·0	June	...	...	22·2	Oct.	...	...	21·9
Mar.	...	...	20·8	July	...	...	22·8	Nov.	...	...	22·2
Apr.	...	...	21·4	Aug.	...	...	23·0	Dec.	...	...	21·7

The figure for December 1931 was 20·9.

The mean of the monthly percentages of insured persons recorded as unemployed for each of the years 1921–32 are as under :—

1921	...	...	17·0	1925	...	...	11·3	1929	...	...	10·4
1922	...	...	14·3	1926	...	...	12·5	1930	...	...	16·1
1923	...	...	11·7	1927	...	...	9·7	1931	...	...	21·3
1924	...	...	10·3	1928	...	...	10·8	1932	...	...	22·1

Employment in Germany, according to the official reports summarized in the *Ministry of Labour Gazette*, improved slowly but on the whole uninterruptedly during the first nine months of 1932 and fell away more rapidly during the last three months. At the end of 1931 the total number recorded as *available for and seeking work* was 5,746,000. At the end of February, 1932, this number had increased to 6,126,000, but thenceforward the number decreased steadily and at the end of September, 1932, had fallen to 5,280,000. There was a fairly rapid rise during the next three months and the figure at the end of December, 1932, stood at 5,922,000, or 176,000 more than at the end of 1931. Of these, 5,773,000 were definitely stated to be out of work and 2,073,000 in receipt of standard or emergency unemployment benefit. The figures for mid-January show no decline. The numbers in receipt of benefit are less by about a million than the numbers receiving benefit at the end of 1931, but this is due to the considerable restrictions on the payment of benefit which have operated during the year 1932.

Returns from German trade unions covering about 3½ million workpeople continued to show a high percentage of unemployment among their members, the mean rate throughout the twelve months, December, 1931, to November, 1932, being as high as 43·5 per cent, with a maximum at the end of March (44·6 per cent). The rate at the end of November, 1932, was 43·2 per cent. as compared with 38·9 per cent. at the end of November, 1931. Throughout the year rather more than 22 per cent. of their members were on short time.

The number of persons on the registers of Employment Exchanges in France at the end of 1932, was 306,700 compared with 186,450 at the end of 1931. The number throughout the year was largely in excess of corresponding figures for 1931, but the comparatively small numbers registering at Exchanges prevent the figures from being a guide to the total amount of unemployment. As a consequence a special official investigation has taken place each month since the beginning of 1931 into the numbers employed and hours worked in mining, industrial, transport, and commercial undertakings employing at least 100 workers. The returns received each month since the enquiry started have shown a marked decrease in the numbers employed compared with the numbers in the corresponding month of the previous year. The reduction in each month of 1931 compared with 1930 averaged 7·5 per cent., and in each month of 1932 compared with 1931 averaged 11·7 per cent. Assuming that the firms making returns are more or less the same throughout the period, it would seem that they are employing at least 15 per cent. less than in 1930.

In Belgium the statistics from the Approved Unemployment Societies show that the numbers of their unemployed members have not varied greatly during the last twelve months, but are consistently higher than in the previous twelve months and very strikingly in excess of the figures for 1930. Taking the twelve months ended October, 1932, the mean rate of unemployment was 19·3 per cent. compared with 9·8 per cent. for November, 1930–October, 1931, and 2·6 per cent. for the twelve months ended October, 1929. At the end of October, 1932, about 17·7 per cent. of the societies' membership were unemployed and 16·8 per cent. intermittently employed.

Employment in Italy, although improving somewhat during the summer months, was definitely worse than a year ago, and at the end of November, 1932, the numbers recorded as unemployed by the National Social Insurance Fund amounted to 1,038,757 compared with 878,267 at the end of November, 1931. Somewhat higher figures, however, than those for November, 1932, were recorded in the first three months of 1932.

In the Scandinavian countries employment in 1932 was considerably worse than in the preceding twelve months. In Denmark, for the year ended November, 1932, the mean rate of unemployment, as shown by returns from trade unions and the Central Employment Exchange, was 31·1 per cent. compared with 17·5 per cent. for the previous twelve months. At the end of November, 1932, the rate had reached 35·1 per cent.

In Sweden and Norway the mean rates of unemployment in trade unions for the twelve months ended October, 1932, were 21·8 per cent. and 24·0 per cent. respectively, compared with 16·0 per cent. and 18·6 per cent. in the previous twelve months.

Employment in the United States continued to decline during 1932. Except for a slight arrest from August to October both the numbers employed and the wages paid by firms employing about four and a quarter million workpeople in various branches of industry and commerce (according to the Federal Bureau of Labour Statistics) showed a decline each month. The decline was roughly 12 per cent. in the numbers employed and rather more than 25 per cent. in the amount of wages paid. The Bureau's index-number of employment, which covers manufacturing industries only, showed a similar trend. The mean index for the twelve months ended November, 1932, was 60·8 (1926=100), compared with 71·7 in the corresponding period of 1931 and 85·1 and 97·8 in periods ending in November, 1930, and November, 1929. The figure for November,

1932 was 59·4 compared with 55·2 in July, 1932, the lowest figure reached by the index-number.

Employment in Canada in 1932 was considerably worse than in 1931. The index-number of employment prepared by the Dominion Bureau of Statistics on the basis of returns received from about 8,000 firms shows a fall of 16 per cent. from 99·1 to 83·2 (1926=100). The mean index-number for the year 1932 was 87·5 compared with 102·5 for 1931, 113·4 for 1930, and 119·0 for 1929. The index-number was at its highest, 127·8, in August, 1929.

Neither in Europe nor in America do the statistics of employment and unemployment give any indication of an appreciable improvement in the state of industry.

The Ministry of Agriculture's monthly index-number of the prices of home-grown agricultural produce in England and Wales showed a further decline in the second half of 1932, and in October the index, for the first time since early in 1914, fell to 100, that is, to the level of the same month in the base years, 1911-14. The average of the six months, July-December, 1932, was 103, a figure which may be compared with the average of 143 reached in the corresponding months of 1927-29 before the beginning of the present depression, a decline of 28 per cent. The downward tendency was observable in practically all commodities, though at the close of the year milk and cheese were slightly better than in December, 1931.

World wheat prices in December reached exceptionally low levels, rates being affected by the enormous "carry over" from previous seasons, and by the diminished demand due both to abundant crops in importing countries and to increasing restrictions on world trade. The statistical position does not, in fact, afford much or any hope that world stocks will be reduced this season, so that the possibility of any material recovery in prices in the near future appears to be remote. British growers, however, are not now so directly interested in the fall in wheat prices, as under the provisions of the Wheat Act they are assured of a standard price of 10s. per cwt. for millable wheat; the actual selling price of English wheat in December was 5s. 3d. per cwt. as compared with 6s. twelve months earlier.

Live-stock prices in England and Wales during the past autumn have been very "unfavourable, though at the end of the year a somewhat firmer tone prevailed.

The monthly index-numbers published by the Ministry of Agriculture for the past six months, with comparative figures for the two previous years, are given below (1911-14 = 100) :—

	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1932	106	105	104	100	101	103
1931	121	121	120	113	112	117
1930	134	135	142	129	129	126

Some valuable data on fertility in 1,698 Amsterdam families of six and more children are contained in *Periodicity, Rhythm and Symmetry with the Births*, a statistical communication of the Municipal Bureau of Statistics of Amsterdam. The book contains a *résumé* in English. The author is Mr. G. Wolda, ornithologist at Wageningen, who claims to have found numerous analogies between "the mass phenomena of reproduction with birds and with human beings." We may appreciate the value of his data without necessarily accepting his more speculative conclusions.

The most frequent interval between births in the Netherlands the author finds to be nineteen months; "there is a preponderant chance of spring conception, whereof the birth follows in February," and the nineteen months interval causes secondary peaks in the birth curve. An attempt is also made to estimate the loss due to birth control in families of various sizes, making a definite assumption as to the maximum naturally occurring birth interval. In families of six, for example, with a maximum natural interval of forty-two months, the loss works out at 22 per cent.

Dr. R. A. Fisher's *Statistical Methods for Research Workers* has now reached a fourth edition. The most important change is the addition of a section on the analysis of covariance, which is fully illustrated by some data from experimental plots of tea bushes. Two other changes are the addition of an historical note on the development of statistical reasoning and the complete rewriting of the appendix on technical notation and formulæ at the end of the third chapter. Here the author stresses the value of his *k*-statistics, which are unbiased estimates made from the sample of the semi-invariants of the population sampled. That the book has reached four editions in a comparatively short space of time is indicative of the author's success in meeting, if not creating, the demand for a book dealing adequately with the modern methods of treating small samples.

We desire to congratulate our distinguished Fellow, Dr. James Bonar, on the publication of the second edition of his *Catalogue of the Library of Adam Smith* (Macmillans, 1932, 21s.). The first

edition was published for the Economic Club in 1894 and was intended "to give a faithful list of texts and papers known to have belonged to the library of Adam Smith, illustrated *pari passu* by quotations showing the use made of them by him, so far as such use was at all traceable." In the intervening years more material has become available, and by the help of the Royal Economic Society it has been possible to prepare this new edition. Dr. Bonar has also extended his labour of love by expanding "the illustration by quotation and reference." His research would have been burdensome to many another man, but we are sure it was not so to such an enthusiast. It is a work which we whole-heartedly admire. We build on the achievements and errors of the past and to trace the evolution of thought is always instructive. Iconoclasm breaks in vain on *The Wealth of Nations*, and on re-reading that foundation of economic science one feels how much more human Adam Smith was than his successors, equipped though they have been with more abundant data and with more perfect instruments of analysis. The book is prefaced by a reproduction of the Tassie medallion of Adam Smith, and the introductory account of the library is illustrated by a ground-plan of his house and a facsimile letter. But next to the portrait of the economist we welcome most the reproduction of the good Scots face of his mother.

Mr. G. Udny Yule, C.B.E., F.R.S., has been elected an honorary member of the Czechoslovakian and Hungarian Statistical Societies.

OBITUARY

SIR BERNARD MALLET

To most people Sir Bernard Mallet's official life is identified with his occupancy of the post of Registrar-General, but to some who knew him before that he is just as definitely linked up with Inland Revenue and Treasury experience. At the Treasury he was Private Secretary to the Parliamentary Secretary, Mr. Akers Douglas, from 1886 to 1891, and to the First Lord of the Treasury, Mr. A. J. Balfour, from 1891 to 1892 and again from 1895 to 1897. He thus had eleven years of Parliamentary connection with Revenue subjects, succeeded by nearly twelve years as a Commissioner of Inland Revenue from November 1897 to July 1909.

The duties of the Junior Commissioners in those days were not exacting, and, although they had their daily routine of departmental affairs, they had no great part or lot in shaping either Departmental or Treasury policy in taxation, these matters being in the province very much of the Chairman and perhaps Deputy-Chairman of the day. Mallet had thus time to ponder that work which issued afterwards in the Royal Statistical Society as the *Multiplier*, while no doubt at the same time he formed the background of interest which led subsequently to the authorship of *British Budgets*.

In the case of the work on the *Multiplier* it may be said quite definitely that the mathematical development was entirely in the hands of Mr. H. C. Strutt, the Assistant Accountant-General, and Bernard Mallet provided interest, impetus, and the opportunity for publicity, which would probably have been denied to a junior official working upon his own account. The first paper was given in 1908 as the development of a new method of estimating capital wealth from the Estate Duty statistics, and the chief interest at the time was the extraordinary difference which came about by this method compared with the direct capitalization by the Giffen method. Dr. Bowley summarized the points when he said that : (1) either the multiplier was too low, or (2) estates were undervalued for probate, or (3) very considerable sums passed *inter vivos* and did not come up for probate. Certain other points of difference need not be here stressed. The matter was considered to be of sufficient interest for Sir Matthew Nathan, when Chairman, to authorize the work of classifying deaths in age groups; the death-

rates of particular age groups were then applied and considerable refinement was possible, the results being given to the Society in a paper by Mallet and Strutt in July, 1915. Although Mallet had left the Department, he continued to take great interest in the work, the actual details and development of which were in the hands of Mr. Strutt. It cannot be said that the whole of the difficulties have even yet been cleared up, but the gap between the two methods is much more satisfactorily accounted for.

In his work on *British Budgets*, although he had considerable assistance from juniors, he was by no means so dependent upon them, and in addition to supervising the whole, a good deal of the work, particularly in the second volume, was his own individual effort.

The impression he left in the Department was one of a pleasant and interesting companion. He had no special penetration, but rather a considerable capacity for sustained interest in any subject that he took up. Members of the Political Economy Club will remember how constant he was in his attendances and how lively in his interest, yet, at the same time, by contrast, how little was his personal initiative in the way of contributions to the discussion. Because of his reluctance to take a prominent part in debate, his influence upon the affairs of the Club may at the time have been under-estimated, but looking back we can see that his solid record of attendance, of organization, and of approval, formed a real contribution to the continuity of the transactions.

In 1909 he was appointed Registrar-General in succession to Sir William Cospatrik Dunbar, and an official partnership with Dr. T. H. C. Stevenson, the Superintendent of Statistics of the Registrar-General's Department, happy in its relationship and its statistical results, was begun, and continued until Sir Bernard's retirement in 1920. During his period of office substantial changes were made in the form of the annual statistical output of the Department and a considerable increase in its bulk. The Census of 1911 was a more exhaustive one than on any previous occasion, particulars regarding the fertility of marriages being collected and tabulated for the first time, and a system of mechanical tabulating adopted.

Sir Bernard possessed a sympathy towards innovation unusual before the war in official circles. Considerable difficulty was experienced in the few years prior to the 1911 Census regarding estimates of post-censal populations for districts. A paper proposing a novel method of making these estimates was read before the Society in 1911, and, as a practical test of the method, Sir Bernard invited the author of it to prepare, in advance of the publication of the Census, estimates for many areas. His practical interest in statistical

research was also shown by his obtaining a Treasury Grant for this class of research in his Department, and some of the results of this were published in a supplement to the Seventy-fifth Annual Report of the Registrar-General on methods of constructing abridged life tables. In the summer of 1915 the compilation of a National Register became of vital importance and the task naturally fell to the Registrar-General's Department. A number of novel features in administration had to be faced, and in particular the staffs of local authorities had to be instructed hurriedly in a matter of some complexity. The difficulties involved were successfully overcome by Sir Bernard's skill and tact, and the Register was established in a surprisingly short time and became the indispensable basis for many of the subsequent developments of war-time. It also fell to his lot to compile and maintain the Register of Belgian refugees who arrived in this country in the early part of the war. He was created a K.C.B. in 1916, and was President of this Society in 1916-17 and 1917-18. He revived the happy procedure by which a President serving for two years gave two Presidential addresses, his first being in November 1916 on "The Organisation of Registration in its bearing on Vital Statistics," while the second one, delivered a year later, was on "Vital Statistics as affected by the War."

During the last years of his life he was identified with the Eugenics Society, and on this part of his work Major Darwin contributes the following appreciation :—

When the name of Sir Bernard Mallet is mentioned casually in conversation, that which will flash at once into the minds of his friends is a memory of his great personal charm, this being certainly by no means a skin-deep characteristic. If thus endowed, a man with noble aspirations will by the very contagion of his character arouse the same motives in those with whom he is working. When Sir Bernard accepted the presidency of the Eugenics Society in 1928, after serving for ten years on its Council, he did so, I am sure, only out of a strong sense of duty; and if, as I believe, he unconsciously made his fellow-workers look on their efforts in the same way as himself, that in itself was an admirable achievement. Any one who is striving to steer the eugenic ship must of all things realize that the greatest difficulties to be overcome will always depend on human folly and human weaknesses. A knowledge of the way in which men's minds work in various circumstances is essential; and this knowledge is most easily acquired by those endowed with wide human sympathies and a strong sense of humour, both of which qualities Sir Bernard possessed in a marked degree. During his presidency, great progress was made especially in regard

to sterilization, whilst several new schemes were initiated in other directions, including a study of the so-called social problem group. He was a member of the International Federation of Eugenical Organizations, attending several of their meetings abroad, and a paper by him was read at the International Congress of Eugenics of 1932 at New York. His health had been failing for some months, and towards the end this constituted a constant handicap; but he never shirked his duties, though doubtless the difficulties which he had to overcome tried him far more seriously. Putting aside this short period of his life, there are very few men whose name will so certainly recall happy pictures to the mind, whilst the widespread sorrow at his death testifies to the solid worth of his qualities.

THOMAS HENRY CRAIG STEVENSON

THOMAS HENRY CRAIG STEVENSON was born at Strabane, County Tyrone, in 1870, and received his scientific education at University College, London. He obtained the diplomas of M.R.C.S., L.R.C.P., in 1896, and graduated M.B. in the University of London. After graduating he set up in general practice, but his interests were soon directed to the public health field. While in practice he read for the public health diploma and his M.D.—which he decided to take in the branch of State medicine. One of his examiners was Sir Arthur Newsholme, and the contact of examiner and examinee was the first in a friendship destined powerfully to affect the course of statistical history. Stevenson received an appointment under Newsholme in the Brighton Public Health Department, and the older man's enthusiasm for statistical analysis was communicated to his assistant. From Brighton, after a short period under the County Medical Officer of Essex, the late Dr. Thresh, Stevenson entered the School Medical Service of the London County Council and from that service passed into that of the Somersetshire County Council, whose school medical officer he became. In 1909 Stevenson was appointed Superintendent of Statistics in the General Register Office, in succession to the late Dr. John Tatham, who was the second in succession to William Farr. From that time Stevenson's life was that of a statistician in the strict sense of the word; but it is material to notice that *before* specializing, he had acquired practical experience of (a) the general practice of medicine, surgery and midwifery, (b) the ordinary work of a large public health department, (c) the work of a school medical officer.

Stevenson's three predecessors were distinguished in various ways. Farr was—Farr! and there is no more to be said. Ogle was a physician and an exact scholar, Tatham an experienced medical

officer of health. Stevenson had less knowledge of general medicine and history than Ogle, less experience of public health administration than Tatham and less originality and versatility than Farr, but his whole stock of knowledge was more complete than that of any of his predecessors. No medical reader of the reports issued from the General Register Office in Stevenson's time can fail to perceive that they are the work of a man to whom statistical analysis is not an end but a means, and a means of discovering preventable evils. Stevenson did not try to attract attention to his discoveries by the use of picturesque rhetoric or quaint illustrations in Farr's way, but his persistence is, to the constant reader, quite as impressive. In the first of the series of newly modelled reports (beginning in 1911) for which he was responsible, one finds an analysis of mortality from pneumonia by age, sex and area, showing that mortality in the North compares badly with that of other parts, and the comment: "Evidently pneumonia is to a large extent a preventable disease, and the North of England has still much to learn with regard to its prevention." In the report of the following year this is repeated, and again in 1913 with the grim addition: "It is a striking fact that all these statements as to relative mortality, copied verbatim from the Report for 1912, apply equally to the year 1913." In 1914, this addition includes the years 1912, 1913, 1914. The same *motif* inspired the increasing elaboration of the analysis of mortality in the first year of life, which characterized his regime. In 1911 mortality in the first year of life was examined in five sub-divisions—deaths under 1 month, 1–3 months, 3–6 months, 6–9 months, 9–12 months. By 1928 Stevenson had secured publication of a detailed analysis of the causes of death in the first 30 minutes of life, and his comments on the data are hardly less vivid than Farr's would have been. "The conclusion seems inevitable that many of these early deaths have been deliberately brought about, and this impression is greatly strengthened by their special incidence on the illegitimate and on the female sex, and by the very significant causal distribution of this excess." . . . "It would appear that, amongst the 'unwanted' illegitimate, females are even more unwanted than males." . . . "One of the most sinister features of this comparison is pictured in Diagram I, which shows that on the first day of life the excess mortality of the illegitimate of each sex is not only, as shown above, especially high, but is rapidly increasing, owing to rise in the rate for the illegitimate coincident with steady slight fall in that for the legitimate."

A desire to tabulate the statistical data in such a way as to bring to light correlation (in the general sense of the word) between variations of mortality and variations of economic or social environ-

ment informed the whole of Stevenson's official work and is as prominent in a paper read to the Society in 1910 as in his latest contribution to our proceedings, his paper of 1928.

Not the least of his services to medical statistics was his gallant and successful effort to maintain and improve the occupational as distinct from the industrial element of classification in the decennial analyses and census returns. In his 1928 paper, Stevenson wrote: "Our so-called occupational classifications in use at previous censuses were really in large measure industrial, being based not entirely upon the nature of the work performed by the individual, but in many cases upon the nature of the employer's business. Thus we distinguished carpenters and clerks—occupational groups from which social position and degree of wealth can be broadly inferred—but we also distinguished as occupations the manufacture of many articles such as motor-cars and bedsteads. So-called 'occupations' of this nature indicate neither the nature of the work performed nor the social position of the worker, as such groups include both large employers and the humblest members of their staffs. The British Census of 1921 avoided such confusion by providing separate tabulations by occupation and by industry, and it is the use of the former which is advocated as a means of social grading."

Few of the readers of that passage know that acceptance of the occupational point of view was not secured without a struggle; it is the *medical* statistician to whom that point of view is of importance, and medical statisticians are not numerous or influential. Medical statisticians were anxious to investigate the putative effect of working conditions and processes upon health, and, of course, from that point of view, whether a painter is employed by a builder and decorator or in a motor-car manufactory is unimportant; from the industrial point of view it is important. That does not mean that an industrial classification may not be of value for statistical purposes, and sometimes, I think, Stevenson carried less than his proper weight in committees owing to a difficulty in seeing a problem from the other man's point of view. To the fact that he had his way in the occupational dispute we may attribute the practically uncontested superiority of our means of assessing the effect of occupation upon mortality over those of most other countries. But there have been times when a certain dourness exaggerated by shyness hampered his success in obtaining improvements or resisting changes not for the better. He had a powerful but not a flexible intellect.

Stevenson's largest single enquiry was his analysis of the data on fertility of marriage which is printed in Vol. XIII (Pt. II) of the Report on the Census of 1911. A report issued twelve years later than the Census and in a new era of fertility—or infertility—inevitably

attracted less attention than its intrinsic merits deserved. Stevenson's methods of analysis were conservative; he did not himself make any use of the calculus of correlation or other "mathematical" methods, but relied on the old plan of detailed tabulation and description, using, however, methods of standardization which Newsholme and he had first introduced to the notice of vital statisticians, viz., the application to statistics of fertility of the method used in connection with rates of mortality by Ogle.

Although, as Dr. Snow pointed out eighteen years ago,* data obtained from surviving parents cannot provide a complete account of changes in national fertility, since there may be a negative correlation between low fertility and the probability of surviving, so that data obtained from survivors may over-estimate the average fertility of a previous generation, the value of the analysis is great. It is doubtful whether any statistician of our time will have the opportunity of handling so large a mass of information, and certain that if anybody does he will profit from Stevenson's work.

This, if Stevenson's greatest statistical work, was hardly the most generally interesting. Probably his investigation of the causes of mortality in the first year of life, to which I have already alluded, and his studies of mortality from cancer are more attractive. Stevenson first demonstrated on an adequate body of data, the influence of marital condition on mortality from cancer of the female sexual organs, that married women died at a higher rate from cancer of the uterus and at a lower rate from cancer of the breast than unmarried women. He also brought to notice the correlation of mortality from cancer of certain sites and economic status, so proving the opinion that cancer, unlike tuberculosis, was not a *morbus pauperum*, to be rather less than a half-truth.

Stevenson was a hard worker and, like some other men of his generation, overtaxed his strength in the war years. Some of his best work was indeed done after the war, and the quality of his annual commentaries on the official data showed no deterioration; but he was older than his years and appreciated the fact. It was hoped that release from official duties might enable him to recuperate. *Dis aliter visum*. He retired on August the 8th, 1931, and died on the 12th of September, 1932. To those who took an active part in the work of the Society he was a familiar figure and a valued friend, having in common with another great statistician whose death we recently lamented, H. E. Soper, a diffidence which made it hard for him to realize how highly his colleagues respected his abilities. He was created C.B.E. in 1919 and the Society conferred on him its greatest distinction, the Guy Medal in gold, in 1920. In 1931 the

* *J.R.S.S.*, Vol. LXXVII, 1914, p. 313.

Royal Society of Medicine conferred on him the Jenner Medal, and a few weeks before he died the Royal College of Physicians awarded him the Bisset Hawkins medal. There are still a few fellows of the Society who may have seen and heard William Farr, but none who can have known him in his prime. We have had the privilege of knowing well that successor of Farr who came nearest to Farr's ideal, and perhaps some of us may be listened to with interest by our grandchildren because we can say that we knew Stevenson. If not, the future of medical statistics is gloomy. M. G.

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— Appendix—Contributo allo studio e alla rappresentazione grafica della "normalità" degli individui e dei fenomeni: *Alfredo Niceforo*.

(A Supplement contains these articles in the original German and French.)

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ADDITIONS TO THE LIBRARY.

Since the issue of Part IV, 1932, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS.

(a) United Kingdom and its several Divisions.

United Kingdom—

Agriculture, Ministry of. Economic series No. 37. Report of the Reorganization Commission for pigs and pig products. London: H.M.S.O., 1932. 9½" × 6"; 108 pp. 6d.

Education, Board of. Educational pamphlet No. 91. Trade schools on the Continent. London: H.M.S.O., 1932. 7½" × 4½"; 113 pp. 2s.

Empire Marketing Board—

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[London: H.M.S.O., 1932. 1s. each.]

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REVENUE OF THE UNITED KINGDOM.

*Net Produce in Quarters of 1932, and in Financial Years ended
March 31, 1931-32, 1930-31, 1929-30, 1928-29.*

(000's omitted.)

QUARTERS, ended	March 31, 1932.	June 30, 1932.	Sept. 30, 1932.	Dec. 31, 1932.	Total for calendar year 1932.
	£	£	£	£	£
Customs	35,370	40,033	42,327	44,812	162,551
Excise	29,000	29,400	31,100	33,700	123,200
Stamps and Estate Duties ...	23,280	21,310	24,480	22,600	91,670
Land Tax and Mineral Rights Duty	660	120	40	30	850
Postal Service	17,300	17,250	16,550	18,800	69,900
Telegraph Service					
Telephone Service					
	105,619	108,113	114,197	119,912	447,841
Property and Income Tax, including Super-Tax	265,995	25,556	32,435	25,760	349,746
	371,614	133,669	146,932	145,702	797,917
Excess Profits Duties, etc. ...	2,500	—	—	—	2,500
Corporation Profits Tax					
Motor Vehicles Duties	16,852	4,283	3,771	2,733	27,639
Crown Lands	210	260	340	370	1,210
Interest on Sundry Loans ...	1,292	1,057	2,178	693	5,220
Miscellaneous and Special Receipts	14,119	564	10,110	3,211	28,004
Appropriation from Rating Relief Suspense Account ...	90	—	—	—	90
Totals	106,707	139,833	163,331	152,709	862,580

YEARS, ended March 31,	1931-32.	1930-31.	1931-32 (compared with 1930-31).		Corresponding years.	
			Increase.	Decrease.	1929-30.	1928-29.
	£	£	£	£	£	£
Customs	136,152	121,401	14,751	—	119,888	118,972
Excise	119,900	124,000	—	1,100	127,500	134,000
Stamps and Estate Duties ...	82,070	103,260	—	21,190	105,440	110,630
Land Tax and Mineral Rights Duty	850	830	20	—	880	810
Postal Service	69,500	69,100	400	—	68,100	65,300
Telegraph Service						
Telephone Service						
	408,472	418,591	15,171	25,290	421,808	429,742
Property and Income Tax, including Super-Tax	364,067	323,877	40,190	—	293,816	293,770
	772,539	742,468	55,361	25,290	715,624	723,512
Excess Profits Duties, etc. ...	2,500	3,000	—	500	2,250	850
Corporation Profits Tax						
Motor Vehicle Duties	27,480	27,792	—	312	26,802	26,357
Crown Lands	1,250	1,280	—	30	1,290	1,210
Interest on Sundry Loans	13,810	32,890	—	19,080	32,639	28,111
Miscellaneous— Ordinary receipts	29,913	34,330	—	4,417	30,365	13,143
Special receipts						
Appropriation from Rating Relief Suspense Account ...	3,990	16,000	—	12,010	—	—
Totals	851,482	857,760	55,361	61,639	814,970	836,435
			NET DEC. £8,278			

Values (c.i.f.) of Imports into the United Kingdom for the years 1930-31-32.*

(From the Monthly Trade Returns, December, 1932.)

	Year ended December 31,			Increase (+) or Decrease (—) in 1932 as compared with 1931.	Increase (+) or Decrease (—) in 1932 as compared with 1930.
	1930.	1931.	1932.		
I. FOOD, DRINK AND TOBACCO—					
A. Grain and flour	£ 72,893,831	£ 55,918,037	£ 58,045,656	+ 2,227,619	— 14,758,175
B. Feeding-stuffs for animals ...	5,715,031	5,379,631	6,510,249	+ 1,160,618	+ 795,215
C. Meat	111,526,075	93,905,218	81,385,317	— 12,519,931	— 30,140,758
D. Animals, living, for food ...	18,317,811	16,014,663	10,657,296	— 5,357,367	— 7,660,515
E and F. Other food and drink ...	251,003,510	234,227,624	207,896,186	— 26,331,438	— 43,107,324
G. Tobacco	15,719,822	11,376,456	10,154,920	— 1,221,536	— 5,564,902
Total, Class I	475,116,083	416,721,659	371,679,624	— 42,042,035	— 100,436,459
II. RAW MATERIALS AND ARTICLES MAINLY UNMANUFACTURED—					
A. Coal	29,120	31,381	26,609	— 7,772	— 2,511
B. Other non-metallic mining and quarry products and the like	5,268,317	3,919,570	3,450,203	— 469,367	— 1,818,114
C. Iron ore and scrap	5,161,302	2,336,590	1,891,701	— 441,889	— 3,269,601
D. Non-ferrous metalliferous ores and scrap	12,231,998	7,229,515	6,093,257	— 1,136,258	— 6,138,741
E. Wood and timber	12,774,541	29,140,529	25,601,990	— 3,538,539	— 17,172,551
F. Raw cotton and cotton waste	44,980,719	27,182,530	31,111,187	+ 3,928,657	— 13,878,562
G. Wool, raw and waste, and woollen rags	15,102,389	34,544,109	33,577,548	— 966,861	— 11,524,811
H. Silk, raw, knubs and nolls ...	1,515,363	1,338,714	1,374,033	— 135,319	— 111,330
I. Other textile materials	9,534,083	7,085,974	6,715,727	— 290,247	— 2,838,356
J. Oil seeds, nuts, oils, fats, resins and gums	33,658,484	24,964,275	22,569,853	— 2,394,422	— 11,088,631
K. Hides and skins, undressed ...	16,126,020	11,696,212	12,100,619	— 404,137	— 4,025,371
L. Paper-making materials	12,073,971	9,976,964	9,801,535	— 175,429	— 2,272,436
M. Rubber	10,722,498	4,196,458	2,466,692	— 2,029,766	— 8,255,806
N. Miscellaneous raw materials and articles mainly un- manufactured	11,220,980	9,212,089	7,650,782	— 1,561,307	— 3,570,198
Total, Class II	250,458,815	173,038,210	161,161,766	— 8,576,441	— 85,997,049
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—					
A. Coke and manufactured fuel	10,000	18,181	24,458	+ 6,277	+ 11,458
B. Pottery, glass, abrasives, &c.	10,900,454	9,603,200	5,130,912	— 4,472,258	— 5,769,512
C. Iron and steel and manu- factures thereof	23,298,891	19,621,620	8,665,211	— 10,956,379	— 14,633,653
D. Non-ferrous metals and manufactures thereof	29,362,996	21,408,132	14,702,240	— 6,705,892	— 14,660,756
E. Outfery, hardware, imple- ments and instruments ...	7,702,204	7,275,917	4,508,825	— 2,767,092	— 3,193,379
F. Electrical goods and apparatus	7,026,676	6,239,770	2,736,492	— 3,503,278	— 4,290,184
G. Machinery	17,920,478	15,339,031	10,329,691	— 5,009,340	— 7,590,787
H. Manufactures of wood and timber	8,738,641	7,533,142	5,445,723	— 2,087,419	— 3,292,918
I. Cotton yarns and manu- factures	9,735,503	8,942,212	1,891,777	— 7,050,465	— 7,843,726
J. Woollen and worsted yarns and manufactures	11,266,774	13,446,767	2,363,180	— 11,083,587	— 11,903,594
K. Silk Yarns and manufactures	11,220,901	8,392,892	3,807,832	— 4,585,060	— 7,413,069
L. Manufactures of other textile materials	15,334,860	14,942,794	8,747,486	— 6,195,308	— 6,587,374
M. Apparel	19,290,632	19,838,807	7,027,404	— 12,811,403	— 12,263,228
N. Chemicals, drugs, dyes and colours	13,571,388	13,841,670	9,578,482	— 4,263,188	— 3,992,906
O. Oils, fats and resins, manu- factured	46,911,999	29,415,121	31,030,129	+ 1,635,008	— 15,191,870

* The value of the Imports represents the cost, insurance and freight; or, when goods are consigned for sale, the latest sale value of such goods.

Values (c.i.f.) of Imports for the years 1930-31-32—Contd.

(From the Monthly Trade Returns, December, 1932.)

	Year ended December 31,			Increase (+) or Decrease (—) in 1932 as compared with 1931.	Increase (+) or Decrease (—) in 1932 as compared with 1930.
	1930.	1931.	1932.		
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED— <i>Contd.</i>	£	£	£	£	£
P. Leather and manufactures thereof	15,255,874	13,239,940	7,674,170	— 5,565,770	— 7,581,704
Q. Paper and cardboard	17,975,372	16,431,232	13,088,790	— 3,342,442	— 4,886,582
R. Vehicles (including locomotives, ships and aircraft)	6,827,794	4,240,095	3,110,176	— 1,120,919	— 3,708,618
S. Rubber manufactures	3,927,200	3,429,850	1,786,257	— 1,643,593	— 2,141,033
T. Miscellaneous articles, wholly or mainly manufactured	28,809,145	28,518,032	15,997,363	— 12,520,669	— 12,811,782
Total, Class III	307,417,875	261,718,435	157,675,658	— 104,042,777	— 119,742,217
IV. ANIMALS, NOT FOR FOOD	3,679,927	3,329,000	2,188,686	— 1,140,314	— 1,491,241
V. PARCEL POST	7,302,561	6,445,334	4,126,991	— 2,318,343	— 3,175,570
Total	1,013,973,261	861,252,638	703,132,725	— 158,119,913	— 310,842,536

Values (f.o.b.) of Exports of Produce and Manufactures of the United Kingdom for the years 1930-31-32.*

(From the Monthly Trade Returns, December, 1932.)

	Year ended December 31,			Increase (+) or Decrease (—) in 1932 as compared with 1931.	Increase (+) or Decrease (—) in 1932 as compared with 1930.
	1930.	1931.	1932.		
I. FOOD, DRINK AND TOBACCO—	£	£	£	£	£
A. Grain and flour	4,256,047	3,316,315	3,315,609	— 706	— 940,438
B. Feeding-stuffs for animals ...	2,171,957	2,087,171	1,578,221	— 508,953	— 593,736
C. Meat	1,487,813	1,230,511	1,060,028	— 170,483	— 427,785
D. Animals, living, for food	221,633	171,989	93,704	— 78,285	— 127,929
E. and F. Other food and drink	31,598,429	23,499,986	22,080,872	— 1,419,114	— 9,517,557
G. Tobacco	8,482,673	5,216,377	4,199,877	— 1,016,500	— 4,282,796
Total, Class I	48,218,652	35,522,352	32,328,311	— 3,194,041	— 15,890,241
II. RAW MATERIALS AND ARTICLES MAINLY UNMANUFACTURED—					
A. Coal	15,661,280	34,653,774	31,631,043	— 3,019,731	— 14,027,237
B. Other non-metallic mining and quarry products and the like	1,610,781	1,082,616	870,967	— 211,649	— 778,814
C. Iron ore and scrap	568,200	420,904	259,906	— 160,998	— 308,294
D. Non-ferrous metalliferous ores and scrap	751,402	457,813	711,098	+ 283,255	— 10,304
E. Wood and timber	281,015	230,024	117,056	— 112,968	— 163,959
F. Raw cotton and cotton waste	600,209	331,547	495,130	+ 163,883	— 104,779
G. Wool, raw and waste, and woollen rags	4,810,931	3,270,906	3,153,964	+ 182,968	— 1,356,967
H. Silk, raw, knubs and noils ...	14,195	11,963	9,885	— 2,078	— 4,310
I. Other textile materials	267,770	201,335	356,365	+ 155,030	+ 88,595
J. Oil seeds, nuts, oils, fats, resins and gums	3,618,620	2,438,216	1,832,199	— 586,017	— 1,766,421
K. Hides and skins, undressed ...	1,438,042	742,176	514,530	— 227,646	— 923,512
L. Paper-making materials	1,048,100	684,006	755,567	+ 71,561	— 292,542
M. Rubber	174,600	104,920	113,464	+ 8,544	— 61,136
N. Miscellaneous raw materials and articles mainly un- manufactured	2,870,344	2,409,076	2,451,193	+ 42,117	— 425,151
Total, Class II	63,760,498	47,039,396	43,625,667	— 3,413,729	— 20,134,831

* The value of the Exports represents the cost and the charges of delivering the goods on board the ship, and is known as the "free on board" value.

Values (f.o.b.) of Exports for the years 1930-31-32—Contd.

(From the Monthly Trade Returns, December, 1932.)

	Year ended December 31,			Increase (+) or Decrease (—) in 1932 as compared with 1931.	Increase (+) or Decrease (—) in 1932 as compared with 1930.
	1930.	1931.	1932.		
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—	£	£	£	£	£
A. Coke and manufactured fuel	3,517,800	2,960,319	2,611,635	— 318,711	— 906,165
B. Pottery, glass, abrasives, &c.....	11,900,652	8,107,168	7,119,913	— 987,555	— 4,180,739
C. Iron and steel and manufactures thereof	51,261,119	30,375,155	28,044,950	— 2,330,205	— 23,216,169
D. Non-ferrous metals and manufactures thereof ...	12,037,798	6,911,361	6,891,581	— 49,777	— 5,146,214
E. Cutlery, hardware, implements and instruments ...	7,336,251	5,333,526	5,551,953	+ 221,427	— 1,781,301
F. Electrical goods and apparatus	11,927,931	7,137,911	5,818,370	— 1,589,571	— 6,079,564
G. Machinery	16,971,006	33,011,639	29,528,769	— 3,182,871	— 17,445,238
H. Manufactures of wood and timber	2,215,109	1,126,965	1,193,022	— 233,913	— 1,022,387
I. Cotton yarns and manufactures	87,586,591	56,598,131	62,845,351	+ 6,247,217	— 21,741,240
J. Woollen and worsted yarns and manufactures	36,962,726	25,150,313	21,004,111	— 1,116,202	— 12,958,615
K. Silk Yarns and manufactures	1,555,561	1,037,560	1,023,467	— 13,093	— 531,097
L. Manufactures of other textile materials	19,657,521	12,884,985	13,151,958	+ 266,973	— 6,405,563
M. Apparel	19,768,021	11,011,095	11,829,755	— 2,184,340	— 7,938,266
N. Chemicals, drugs, dyes and colours	21,958,176	17,017,839	17,377,624	+ 359,685	— 1,580,552
O. Oils, fats and resins, manufactured	7,169,809	5,305,751	5,158,841	— 146,910	— 2,300,965
P. Leather and manufactures thereof	5,261,906	3,313,955	2,965,186	— 348,769	— 2,296,720
Q. Paper and cardboard	8,468,315	6,324,269	6,509,193	+ 184,921	— 1,959,122
R. Vehicles (including locomotives, ships and aircraft)	50,992,306	29,713,371	29,713,716†	— 8,969,625	— 30,248,580
S. Rubber manufactures	2,829,532	2,137,182	1,912,966	— 194,216	— 886,566
T. Miscellaneous articles wholly or mainly manufactured	30,410,040	22,636,715	20,925,992	— 1,710,723	— 9,514,048
Total, Class III	140,011,779	292,028,579	275,601,688†	— 16,426,891	— 164,410,091
IV. ANIMALS, NOT FOR FOOD	1,502,029	1,094,271	614,387	— 475,887	— 883,642
V. PARCEL POST	17,232,558	14,936,997	12,963,732	— 1,973,265	— 4,268,826
Total	570,755,416	390,691,598	365,137,745†	— 25,483,813	— 205,617,631

Values (f.o.b.*) of Exports of Imported Merchandise for the years 1930-31-32.

(From the Monthly Trade Returns, December, 1932.)

	Year ended December 31,			Increase (+) or Decrease (—) in 1932 as compared with 1931.	Increase (+) or Decrease (—) in 1932 as compared with 1930.
	1930.	1931.	1932.		
I. FOOD, DRINK AND TOBACCO—	£	£	£	£	£
A. Grain and flour	1,722,496	1,021,052	1,216,496	+ 195,443	— 506,001
B. Feeding-stuffs for animals ..	189,881	165,837	111,137	— 54,700	— 78,744
C. Meat	3,202,645	2,628,915	1,177,980	— 1,150,965	— 1,724,665
D. Animals, living, for food	2,609	1,071	197	— 574	— 2,112
E and F. Other food and drink	17,699,523	15,718,765	11,733,025	— 3,985,140	— 5,966,898
G. Tobacco	839,075	607,275	641,900	+ 34,625	— 297,175
Total, Class I	23,756,229	20,142,915	15,181,634	— 4,961,311	— 8,574,595

* The value of the Exports represents the cost and the charges of delivering the goods on board the ship, and is known as the "free on board" value.

† Amended aggregates.

*Values (f.o.b.) of Exports of Imported Merchandise for the years
1930-31-32—Contd.*

(From the Monthly Trade Returns, December, 1933.)

	Year ended December 31,			Increase (+) or Decrease (—) in 1932 as compared with 1931.	Increase (+) or Decrease (—) in 1932 as compared with 1930.
	1930.	1931.	1932.		
	£	£	£	£	£
II. RAW MATERIALS AND ARTICLES MAINLY UNMANUFACTURED—					
A. Coal	—	—	—	—	—
B. Other non-metallic mining and quarry products and the like	368,624	211,682	136,110	— 75,572	— 232,514
C. Iron ore and scrap	5,117	1,780	97	— 1,653	— 5,020
D. Non-ferrous metallic ores and scrap	215,330	187,560	73,900	— 113,660	— 171,430
E. Wood and timber	156,003	288,586	179,613	— 108,913	— 276,450
F. Raw cotton and cotton waste	3,379,703	1,190,970	1,587,900	+ 396,930	— 1,791,803
G. Wool, raw and waste, and woollen rags	16,893,708	11,070,560	12,032,990	+ 962,430	— 4,860,718
H. Silk, raw, knubs and nolls	16,729	8,598	17,822	+ 8,724	+ 593
I. Other textile materials	781,327	455,501	179,816	— 275,688	— 601,511
J. Oil seeds, nuts, oils, fats, resins and gums	1,453,634	895,979	491,404	— 401,675	— 959,130
K. Hides and skins, undressed	9,862,799	8,437,920	6,808,688	— 1,629,332	— 3,054,211
L. Paper-making materials	26,819	61,781	68,647	+ 1,137	+ 36,828
M. Rubber	3,596,153	1,816,258	1,273,366	— 542,892	— 2,323,087
N. Miscellaneous raw materials and articles mainly un- manufactured	1,283,119	1,080,209	763,969	— 316,210	— 519,150
Total, Class II	38,360,355	25,710,369	23,611,752	— 2,098,617	— 14,757,603
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—					
A. Coke and manufactured fuel ...	81	116	352	— 94	+ 271
B. Pottery, glass, abrasives, &c.	161,303	115,662	50,803	— 55,859	— 101,500
C. Iron and steel and manu- factures thereof	265,171	159,709	73,632	— 86,077	— 191,539
D. Non-ferrous metals and manufactures thereof	2,795,380	1,310,034	1,312,012	— 198,022	— 1,483,368
E. Cutlery, hardware, imple- ments and instruments ...	1,310,139	1,015,187	674,173	— 311,014	— 635,966
F. Electrical goods and apparatus	481,615	215,376	144,708	— 70,668	— 339,937
G. Machinery	1,556,545	1,203,945	910,218	— 293,727	— 646,327
H. Manufactures of wood and timber	622,171	470,929	231,131	— 239,798	— 391,040
I. Cotton yarns and manu- factures	545,683	344,790	224,206	— 120,584	— 321,477
J. Woollen and worsted yarns and manufactures	1,567,822	1,025,919	735,091	— 290,828	— 832,731
K. Silk Yarns and manufactures	1,100,051	584,408	385,970	— 198,438	— 714,084
L. Manufactures of other textile materials	2,207,385	1,522,145	910,092	— 606,053	— 1,291,293
M. Apparel	1,276,488	1,186,200	422,569	— 763,631	— 853,919
N. Chemicals, drugs, dyes, and colours	939,241	1,133,983	554,970	— 579,013	— 384,271
O. Oils, fats and resins, manu- factured	2,823,733	1,838,920	1,740,967	— 97,953	— 1,082,766
P. Leather and manufactures thereof	1,904,986	1,506,295	1,016,161	— 490,134	— 888,825
Q. Paper and cardboard	269,041	192,544	105,467	— 87,077	— 163,574
R. Vehicles (including loco- motives, ships and aircraft)	639,320	449,794	313,170	— 136,624	— 326,150
S. Rubber manufactures	118,034	100,606	84,449	— 16,157	— 33,585
T. Miscellaneous articles wholly or mainly manufactured	3,487,511	2,833,776	1,897,460	— 936,316	— 1,590,051
Total, Class III	24,074,733	17,410,068	11,802,801	— 5,608,067	— 12,272,132
IV. ANIMALS, NOT FOR FOOD	635,092	603,507	317,606	— 285,961	— 317,486
Total	86,835,409	63,887,549	50,913,593	— 12,963,956	— 35,921,816

BANK OF ENGLAND.

Pursuant to the Act 7th and 8th Victoria, cap. 32 (1844),
(000's omitted.)

1	2	3	4	5	6	7	8
ISSUE DEPARTMENT.						COLLATERAL COLUMNS.	
Liabilities.	DATES.	Assets.				Notes in Hands of Public (col. 1 less Notes in Reserve, col. 17).	Minimum Discount Rate.
Notes Issued.	(Wednesdays.)	Govt. Debt (£11,015) and Govt. Securities.	Other Securities.	Gold Coin and Bullion.	Silver Coin.		
£		£	£	£	£	£	Per cent.
395,750	Jan. 6.....	253,982	17,167	120,750	3,851	362,859	6
395,702	" 13.....	251,112	17,039	120,762	3,849	354,744	
395,763	" 20.....	254,469	16,683	120,763	3,848	347,879	
395,763	" 27.....	256,167	14,982	120,763	3,851	345,869	
395,765	Feb. 3.....	257,599	13,547	120,765	3,851	347,666	
395,765	" 10.....	260,090	11,057	120,765	3,853	346,519	
395,766	" 17.....	262,309	8,443	120,766	3,818	344,882	
395,773	" 24.....	264,588	6,563	120,773	3,849	346,405	5
395,801	Mar. 2.....	258,549	12,623	120,801	3,828	351,786	
395,802	" 9.....	260,038	11,168	120,802	3,794	354,475	
395,805	" 16.....	257,968	13,321	120,805	3,801	353,714	4
395,807	" 23.....	252,810	18,380	120,807	3,810	358,836	3½
395,807	" 30.....	251,879	19,315	120,807	3,806	360,520	
395,807	Apr. 6.....	245,402	25,797	120,807	3,801	359,701	
395,808	" 13.....	234,309	36,891	120,808	3,780	356,753	
395,815	" 20.....	219,696	51,487	120,815	3,817	354,271	
395,816	" 27.....	221,002	50,196	120,816	3,802	352,815	3
395,816	May 4.....	218,560	52,629	120,816	3,811	356,580	
395,816	" 11.....	206,525	64,664	120,816	3,811	358,314	
397,830	" 18.....	209,693	61,487	122,830	3,820	358,440	2½
400,032	" 25.....	212,031	59,155	125,032	3,814	354,221	
403,617	June 1.....	203,137	68,052	128,617	3,811	355,414	
406,721	" 8.....	208,099	63,088	131,721	3,813	357,238	
409,480	" 15.....	210,518	60,608	134,480	3,811	357,426	
410,721	" 22.....	216,680	55,607	136,721	3,813	358,548	
411,143	" 29.....	220,547	50,639	136,113	3,814	363,083	
411,144	July 6.....	252,542	18,646	136,144	3,813	366,679	2
411,396	" 13.....	252,387	18,801	136,396	3,812	366,271	
411,584	" 20.....	262,276	18,909	136,584	3,816	365,759	
412,726	" 27.....	262,394	18,799	137,726	3,807	369,286	
413,563	Aug. 3.....	249,228	21,946	138,563	3,826	374,728	
413,563	" 10.....	248,953	22,228	138,563	3,819	370,819	
413,728	" 17.....	248,960	22,223	138,728	3,817	365,957	
413,728	" 24.....	248,787	22,392	138,728	3,821	363,881	
413,906	" 31.....	248,892	22,294	138,906	3,814	365,287	
414,031	Sept. 7.....	259,979	11,210	139,031	3,811	365,122	
414,292	" 14.....	261,688	9,597	139,292	3,815	362,285	
414,421	" 21.....	261,650	9,638	139,421	3,812	359,266	
414,421	" 28.....	261,504	9,683	139,421	3,813	359,784	
414,422	Oct. 5.....	260,050	11,129	139,422	3,821	362,522	
414,422	" 12.....	260,014	11,169	139,422	3,817	361,414	
414,422	" 19.....	258,432	12,767	139,422	3,811	359,218	
414,422	" 26.....	259,085	12,096	139,422	3,819	358,430	
414,422	Nov. 2.....	259,190	12,002	139,422	3,808	361,472	
414,422	" 9.....	259,156	12,031	139,422	3,813	361,210	
414,422	" 16.....	265,092	6,094	139,422	3,814	359,397	
414,422	" 23.....	265,005	6,182	139,422	3,813	357,847	
414,422	" 30.....	264,849	6,634	139,422	3,817	358,843	
414,422	Dec 7.....	264,529	6,657	139,422	3,814	365,662	
414,422	" 14.....	266,052	5,130	139,422	3,818	372,236	
394,788	" 21.....	266,126	5,063	119,788	3,811	370,098	
394,788	" 28.....	266,227	5,068	119,788	3,715	371,193	

WEEKLY RETURN.

for Wednesday in each Week, during the Year 1932.

(000's omitted.)

9	10	11	12	13	14	15	16	17	18
BANKING DEPARTMENT.									
Liabilities.				DAYS. (Wednes- days.)	Assets.				Totals of Liabilities and Assets.
Capital (£14,553) and Res.	Public Deposits.	Banker's Deposits.	Other Deposits.		Govt. Securities.	Dis- counts and Ad- vances.	Other Securities.	Reserv. (Notes and Coin).	
£	£	£	£		£	£	£	£	£
18,035	15,681	81,824	38,503	Jan. 6	64,891	18,899	35,789	33,466	154,045
18,064	22,361	68,702	37,912	" 13	53,561	15,846	36,046	11,587	147,040
18,085	20,813	77,482	38,444	" 20	52,431	14,031	39,920	48,443	154,825
18,101	15,321	74,304	38,208	" 27	45,311	12,947	37,196	50,481	145,935
18,128	14,802	77,326	32,845	Feb. 3	40,701	13,631	40,120	48,647	143,102
18,150	16,435	66,998	32,728	" 10	34,626	13,008	36,910	19,775	134,319
18,191	15,359	70,456	31,989	" 17	33,496	11,945	39,124	51,485	136,000
18,185	14,125	67,921	32,198	" 24	33,676	11,493	37,321	49,913	132,433
18,225	7,023	80,183	33,476	Mar. 2	47,236	11,357	35,948	44,667	139,208
18,242	7,836	83,565	33,182	" 9	54,371	11,845	44,930	41,981	152,827
18,263	9,477	73,054	32,133	" 16	40,296	11,379	38,797	42,747	133,219
18,218	10,439	73,419	32,970	" 23	37,616	11,273	48,644	37,574	135,107
18,231	27,231	51,566	31,381	" 30	35,696	11,725	51,087	36,903	134,111
17,651	9,993	79,542	33,611	Apr. 6	51,111	12,164	40,910	36,646	140,831
17,652	12,259	78,447	32,824	" 13	55,386	11,268	34,834	39,695	141,183
17,660	9,149	72,840	31,585	" 20	57,606	11,198	33,283	42,168	134,245
17,710	23,351	68,284	35,283	" 27	62,621	11,535	16,818	43,662	134,636
17,711	10,207	75,060	36,670	May 4	69,076	11,585	19,228	39,880	139,769
17,762	13,719	78,029	33,180	" 11	72,136	12,096	20,288	38,171	142,691
17,767	21,427	71,602	32,618	" 18	72,945	11,689	21,698	40,083	146,415
17,775	23,606	77,541	32,949	" 25	69,375	12,172	23,788	46,540	151,875
17,784	18,553	89,956	34,150	June 1	73,914	12,482	25,120	18,928	160,444
17,819	25,577	85,846	33,472	" 8	74,260	12,011	25,622	50,233	162,716
17,868	20,568	87,546	33,987	" 15	68,775	12,691	25,711	52,791	159,971
17,906	35,577	73,060	33,146	" 22	66,645	14,112	26,565	52,928	160,280
17,996	17,993	86,565	34,736	" 29	67,170	14,889	26,352	18,870	157,281
18,039	20,947	80,923	31,211	July 6	67,627	14,991	26,247	45,286	154,151
18,062	17,047	82,759	33,567	" 13	65,786	14,771	24,948	45,933	151,438
18,070	13,379	88,024	33,728	" 20	66,231	14,307	26,008	46,664	153,210
18,116	11,243	88,186	34,561	" 27	68,771	15,280	23,767	44,291	152,109
18,135	11,491	84,952	36,300	Aug. 3	75,970	14,311	20,917	39,672	150,882
18,158	10,668	85,322	34,579	" 10	70,554	15,236	19,338	43,600	148,728
18,176	9,806	89,755	34,464	" 17	70,164	14,685	18,709	48,644	152,202
18,189	22,203	79,947	34,429	" 24	71,279	13,266	19,510	50,714	154,769
18,227	20,727	79,549	35,406	" 31	73,149	12,159	19,803	49,519	153,910
18,230	7,618	91,507	33,297	Sept. 7	69,933	12,271	18,611	49,835	150,653
18,235	12,933	89,827	33,157	" 14	70,863	12,052	18,301	52,937	154,153
18,234	23,915	82,587	32,904	" 21	70,998	12,006	18,527	56,110	157,644
18,230	23,418	80,627	33,397	" 28	69,918	12,069	18,073	55,613	155,673
17,637	11,689	85,690	34,633	Oct. 5	67,708	11,676	17,387	52,879	149,650
17,654	15,033	85,534	35,286	" 12	68,108	11,644	17,725	53,981	151,458
17,664	30,751	71,934	33,741	" 19	66,238	11,007	20,048	56,198	154,091
17,686	25,426	77,336	33,588	" 26	66,998	11,597	18,434	57,010	154,039
17,703	7,018	102,672	34,898	Nov. 2	78,813	11,954	17,336	53,988	162,291
17,728	20,428	79,858	33,857	" 9	68,053	17,787	15,233	54,233	151,872
17,745	20,447	82,500	33,198	" 16	68,563	17,795	17,478	56,055	153,891
17,781	26,531	78,082	33,742	" 23	68,582	11,958	18,021	57,578	156,139
17,843	10,147	90,532	37,064	" 30	68,872	11,867	18,274	56,575	155,588
17,873	8,522	104,252	34,454	Dec. 7	85,844	11,807	17,725	49,727	165,103
17,886	8,537	86,291	34,368	" 14	74,249	11,740	18,048	43,049	147,048
17,900	7,826	98,898	33,989	" 21	99,677	11,833	21,574	25,530	158,614
17,988	8,865	102,410	33,780	" 28	102,872	18,509	27,738	24,401	163,020

FOREIGN EXCHANGES.—*Quotations as under, LONDON on Paris, Berlin and Calcutta; New York and Hong Kong on LONDON, 1932.*

DATE (Wednesdays.)	1	2	3	4	5	6		7
	London on Paris.	London on Berlin.	London on Calcutta.	New York on London.	Hong Kong on London.	Price per Ounce.		
	Cables (middle rate).	Cables (middle rate).	Demand (middle rate).	Cables (closing rate).	T.T.	Gold Bars (fine).	Silver Standard Bars (cash).	
1932.	<i>f. c.</i>	<i>Reich- marks.</i>	<i>s. d.</i>	<i>\$ c.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	
Jan. 6.....	85·65½	14·17	1·6½ ₂	3·35½	1·5½ ₁₀	122·9	1·8½ ₁₀	
„ 20.....	88·90½	14·68½	1·6½ ₈	3·45	1·5½ ₄	120·0	1·6½ ₁₀	
Feb. 3.....	87·90½	14·60	1·6½ ₈	3·44½	1·6½ ₈	119·5	1·7½ ₄	
„ 17.....	87·56½	14·52½	1·6½ ₂	3·44½ ₁₀	1·5½ ₂	120·1	1·7½ ₁₀	
Mar. 2.....	88·46½	14·64½	1·6½ ₈	3·48½	1·5½ ₈	118·10	1·7½ ₈	
„ 16.....	94·03½	15·24	1·6½ ₈	3·62½	1·4½ ₈	114·0	1·6½ ₈	
„ 30.....	95·06½	15·66½	1·6½ ₈	3·77½	1·3½ ₄	110·5	1·5½ ₈	
Apr. 13.....	95·90½	15·93½	1·6½ ₂	3·78	1·3½ ₁₀	109·5	1·4½ ₈	
„ 27.....	92·87½	15·40	1·6	3·66½	1·3½ ₈	113·5	1·5½ ₁₀	
May 11.....	93·09½	15·38½	1·6	3·67½	1·3½ ₁₀	112·11	1·5½ ₁₀	
„ 25.....	93·40½	15·58½	1·5½ ₂	3·69½	1·3½ ₁₀	112·8	1·4½ ₈	
June 8.....	93·9½	15·46½	1·5½ ₂	3·67½	1·3½ ₈	113·0	1·5	
„ 22.....	92·15½	15·27½	1·5½ ₁₀	3·62½	1·3½ ₁₀	114·0	1·4½ ₁₀	
July 6.....	90·53½	15·04	1·6½ ₂	3·57	1·3½ ₈	116·0	1·4½ ₁₀	
„ 20.....	91·03½	14·99	1·6½ ₂	3·56½	1·3½ ₁₀	115·7	1·4½ ₈	
Aug. 3.....	89·65½	14·76½	1·6½ ₂	3·51½	1·3½ ₈	117·2	1·5½ ₁₀	
„ 17.....	88·59	14·59	1·6½ ₂	3·47½	1·4½ ₁₀	118·7	1·6½ ₁₀	
„ 31.....	88·53½	14·58	1·6½ ₈	3·47	1·4½ ₈	118·10	1·6½ ₁₀	
Sept. 14.....	88·90½	14·64	1·6½ ₂	3·47½ ₁₀	1·4½ ₁₀	118·3	1·5½ ₁₀	
„ 28.....	88·09½	14·49½	1·6½ ₂	3·45	1·4½ ₁₀	119·5	1·5½ ₂	
Oct. 12.....	87·78½	14·49	1·6½ ₂	3·44½ ₁₀	1·4½ ₁₀	119·9	1·5½ ₂	
„ 26.....	84·25	13·93	1·6½ ₂	3·27½	1·4½ ₁₀	124·3	1·5½ ₂	
Nov. 9.....	84·26½ ₁₀	13·93½	1·6½ ₂	3·29½	1·4½ ₁₀	124·8½	1·6½ ₈	
„ 23.....	83·53½	13·75	1·6½ ₁₀	3·25½ ₈	1·4½ ₁₀	125·10½	1·6½ ₈	
Dec. 7.....	82·59½	13·56	1·6½ ₁₀	3·24½	1·4½ ₁₀	128·1	1·5½ ₂	
„ 21.....	85·57	13·99	1·6½ ₁₀	3·34½	1·3½ ₁₀	123·5	1·4½ ₁₀	

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MIGRATION FROM AND TO THE UNITED KINGDOM.

By H. LEAK and T. PRIDAY.

[Read before the Royal Statistical Society, January 17th, 1933, PROFESSOR
MAJOR GREENWOOD, F.R.S., Vice-President, in the Chair.]

THE subject of migration statistics is one on which no paper has been read before the Society during this century, and there has been no official publication surveying the post-war data. For some forty years before the war, the Board of Trade issued annually a report on emigration, but the last issue of such a report related to the year 1913 (Cmd. 295 of 1914), and for subsequent years we have to rely on the particulars published each quarter in the *Board of Trade Journal*.

This paper falls naturally into four divisions. The first part is concerned with the material available, including the relation of post-war to pre-war data, a comparison between the migration figures based on the Board of Trade returns and the inter-censal changes recorded by the Census of Population, and a short historical survey. The second deals with factors affecting post-war migration, of which the chief are social insurance, national assistance to emigrants and the United States quota system. The third part relates to the main features of post-war migration, particularly in regard to the inter-censal period 1921-31. This part compares pre-war and post-war migration and includes particulars of the sex, ages and occupations of British migrants to countries out of Europe, and an analysis of British emigration which has not previously been made, viz. a comparison of the extent of pre-war and post-war migration by families. The fourth part deals with the passenger movement to all countries and includes information relating to the number of passengers travelling for business or pleasure, the movement of aliens to and from this country and the class of travel. The paper concludes with a general summary.

I. THE COLLECTION OF PASSENGER STATISTICS.

The first General Report of the Colonial Land and Emigration Commissioners was published in 1840, and statistics in respect of emigration were included in their second and subsequent Annual Reports (for the years 1841 to 1872), which dealt mainly with the administration of the Passengers Acts for the settlement of British emigrants in the various British Dominions and Colonies overseas. By the Merchant Shipping Act of 1872, all powers and duties conferred and imposed on the Emigration Commissioners by the Passengers Acts of 1855 and 1863 were, from the 1st January, 1873, transferred to the Board of Trade, and the information available in respect of passenger movement back to 1815 was incorporated in that Department's report on "Emigration from the United Kingdom, 1873." From that date annual reports were made by the Board up to and including 1913. The primary object of the Passengers Acts above referred to was not to furnish statistics of migration, but to regulate ships engaged in carrying certain classes of passengers to, but not from, places out of Europe. Under these Acts the masters of such ships were required to deposit lists of their passengers in a prescribed form with the Officers of Customs before demanding a clearance, and from such lists the tables of "emigration" were prepared. Properly speaking they were lists of passengers leaving the United Kingdom in certain vessels for places out of Europe. There was no record of migration to European countries and the records did not necessarily cover all vessels proceeding to places out of Europe, the masters of ships carrying cabin passengers only not being under a statutory obligation to furnish such lists, though most did so.

As regards the records of "immigration," they were most imperfect before 1870, and hardly existent before 1860. From 1870 onwards, however, the captain of every ship bringing steerage passengers to the United Kingdom from places out of Europe had to deliver a list at the port of arrival, and from these lists tables of "immigration" were compiled. It may be added that although, for vessels arriving in this country from places out of Europe, masters of such ships were not by law required to furnish information relating to passengers other than those in the steerage, as a matter of fact they did generally supply information as regards cabin passengers also.

The separation of passengers of British nationality from other passengers was not made in the returns until 1853 for outward passengers and not until 1876 for inward passengers, and the lack of this information makes it impossible to estimate with any accuracy

the net loss of British subjects by migration for any year earlier than 1876.

From 1st April, 1912, a revised form of passenger list came into use, in which, in place of the statement of the nationality of British passengers as English, Welsh, Scottish, Irish or British Colonial, there were required particulars of the countries of last and of intended future permanent residence—residence for a year or more being treated as permanent residence for the purpose of this classification. From the particulars thus made available, it was for the first time possible to separate emigrants from, and immigrants to, the United Kingdom from other passengers to and from countries out of Europe. Passengers recorded as altering their country of permanent residence from or to the United Kingdom have been classed as “emigrants” or as “immigrants” respectively. The regulations have now been amended to provide specially for vessels engaged in pleasure cruises. A copy of an outward passenger list is shown in Appendix V.

Relation of pre-war to post-war Statistics.

Prior to 1st April, 1912, when the basis of the statistics was changed, the best available estimate of net emigration was afforded by the excess of passengers of British nationality recorded as leaving this country for overseas destinations over the number arriving from overseas countries. Similar figures are available for the period after the war and are given in the following table with figures

TABLE I.

	Balance Outward			
	To all Countries outside Europe		To United States.	
	British Passengers.	British Migrants.	British Passengers.	British Migrants.
1913	241,997	303,685	52,155	78,072
1919	27,002	53,912	6,971*	3,296
1920	172,747	199,047	49,783	60,067
1921	118,938	128,110	33,756	42,468
1922	99,882	106,070	27,689	37,291
1923	197,817	208,695	78,088	95,213
1924	98,584	107,822	10,646	16,964
1925	106,893	112,288	37,718	46,660
1926	142,648	143,776	40,634	47,505
1927	120,949	123,024	35,299	41,538
1928	98,193	100,267	30,149	35,935
1929	103,707	106,183	34,261	41,536
1930	31,902	39,380	23,448	32,017
1931	38,885*	39,069*	16,354*	10,399*
1932	56,282*	54,252*	23,899*	16,310*

* Inward balance.

showing the excess of British emigrants over immigrants. In this table the figures are inclusive of the movement from and to the Irish Free State, both as regards sailings and arrivals at Southern Irish ports and at ports in the United Kingdom.

The divergence between the balance outward of British passengers and British migrants in the early years after the new method of recording migration was introduced suggests that the early records are somewhat defective, but there is now a considerable degree of consistency between the two sets of figures. The figures for the years immediately after the war are affected by the return to their homes overseas of many persons who had come to this country during the war, and for the latest years (except 1930) the net migration as recorded has exceeded the net outward movement of British passengers by less than 5 per cent. It would appear, therefore, that the pre-war records of net passenger movement can be regarded as giving in the aggregate a reasonably accurate picture of migration. This is not necessarily true of the movement to individual countries, since, in the passenger movement record, countries to or from which passengers travel are determined solely by the countries in which they landed or embarked, while in the migration record the country of ultimate destination or origin, so far as known, is shown. This divergence is most marked in the movement to the United States, and it will be seen from the above table that the excess outward of British passengers to the United States has consistently been less than the net migration to that country. For this, two probable reasons may be advanced :—(1) that more passengers travelling for business or pleasure from the United States arrive in this country via the Continent than return via the Continent, and (2) that, of the visitors to this country from the United States who have a permanent residence there while retaining their status as British subjects, a substantial number are recorded when returning to their homes as changing their permanent residence and thus swell the figures of emigration to that country.

*Relation of Migration Statistics to Inter-censal Changes
in Population.*

An attempt may be made to measure the accuracy of the Board of Trade returns for the past sixty years by comparing the estimates based upon them with the results shown by the Census Reports. According to the Reports of the Registrar-General for England and Wales and for Scotland, and to the Statistics of Population for the Irish Free State and Northern Ireland, the movements in the United Kingdom in the last six decades were as shown in the following table; the Board of Trade Passenger Return figures shown in

Column (4) represent the outward balance of British subjects to non-European countries in the five decades 1871-81 to 1911-21 and the outward balance of all nationalities to all places in the decennium 1921-31.

TABLE II.

	Annual Average.			
	Natural Increase.	Inter-censal Increase.	Outward Balance of Migration.	Outward Balance of British Subjects. (Board of Trade Returns.)
	(1)	(2)	(3)	(4)
1871-1881 ...	432,000	340,000	92,000	(c) 103,000
1881-1891 ...	440,000	285,000	155,000	165,000
1891-1901 ...	430,000	373,000	57,000	68,000
1901-1911 ...	484,000	376,000	108,000	(d) 150,000
1911-1921 ...	360,000	183,000	(b) 107,000	86,000
1921-1931 ...	(a)	(a)	67,000	(d) 69,000

(a) The Census of the Irish Free State and of Northern Ireland was taken in 1926; the figures for Ireland for the inter-censal period are estimated.

(b) Allowance has been made for war deaths abroad.

(c) Partly estimated.

(d) Allowance has been made for the reduction in strength of Army Establishments abroad.

When it is remembered that the Board of Trade Returns for periods prior to 1921-31 are lacking in statutory information respecting the net movement of British subjects and aliens to and from the Continent of Europe, the outward balances as estimated from the Board of Trade and from the Census figures are not widely at variance for the decades shown in the table except for the decennium 1901-11. As regards that period it would appear probable from the voluntary information available that there was an excess inward of aliens from the Continent of Europe to this country, but the extent of this influx cannot be measured with any degree of accuracy. It is also probable that the distinction of British from other nationalities in the passenger lists was noticeably imperfect in the first half of the decade and that the inward lists of passengers during that period may have been incomplete as regards cabin passengers.

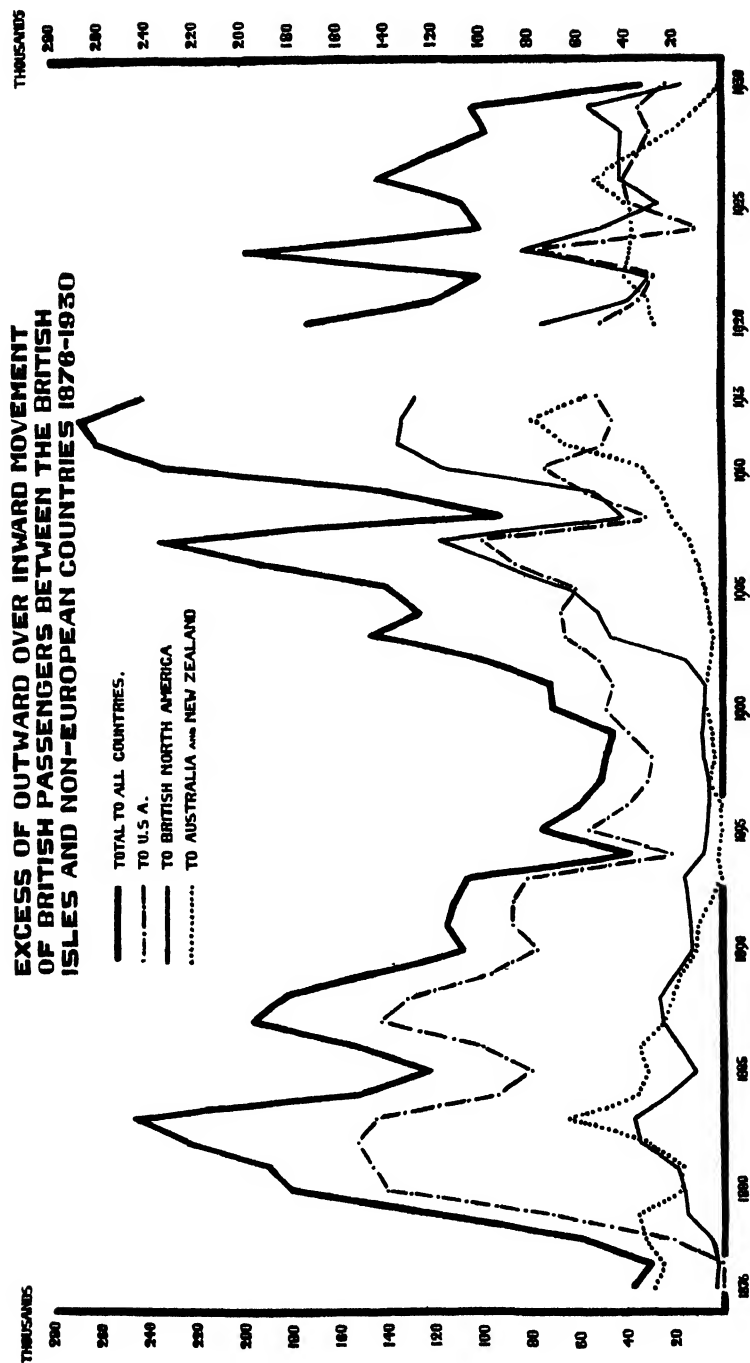
Historical Survey.

With the advent of the ocean-going steamship in the middle of the nineteenth century, the number of persons travelling to places outside Europe for business or pleasure increased so greatly as to render the only statistics available regarding passenger movement of little value for the purpose of measuring the volume of migration,

but before that time the outward movement of passengers was probably not widely divergent from the outward movement of emigrants. The records as already mentioned start with the year 1815, and for about 20 years after that date the movement of outward passengers was almost entirely confined to the North American continent, the number of migrants to our North American Colonies being, in general, greater than that to the United States; it was not till seventy years later that the net migration to British North America was again appreciably in excess of that to the United States. The number of outward passengers to the United States increased enormously after 1845, and two years later there was an isolated year with an abnormal number of passengers to British North America, 109,680 as compared with 43,439 the previous year and 31,065 the subsequent year. This very large movement was due to the famine arising from the failure of the potato crop in Ireland in 1846, and it is recorded that owing to fever and other causes one-sixth of those who emigrated to the North American Colonies in 1847 died.

The net migration of British passengers to destinations outside Europe is illustrated in the accompanying chart, which shows separately the movement to British North America, the United States, and Australia and New Zealand. The figures on which the chart is based are summarized for five-yearly periods in Appendix II.

The chart starts with the year 1876, when migration from this country was at a very low ebb, the total outward movement of passengers in that year being only about half the average for the preceding seven years. About three-quarters of the migration was to Australia and New Zealand in both 1876 and 1877, the migration to North America being negligible, but for the next twenty-five years the total movement was dominated by the migration to the United States. In the pre-war period there are three very marked dips in the curve showing the total movement in 1884-5, 1894, and 1908; each of these was related to a financial crisis in the United States, and it may be noted that in this country there was a reduction, in each year mentioned, of some 7 or 8 per cent. in wholesale prices as recorded by the Sauerbeck index, and a fall in the bank rate. In 1889 and 1890, on the other hand, when migration to the United States was also decreasing rapidly, prices were steady and the bank rate was rising consequent upon excessive investment in the Argentine and South Africa. The general movement is characterized by a rapid increase from 1877 to 1883, which may be traced to depression in this country resulting largely from competition by Germany and the United States. Small wonder that persons here thought it a good thing at that time to try to better themselves in a country so pros-



perous as the United States. There was also at this time a relatively large migration to Australasia, this movement being very largely migration assisted by the Australasian Governments at a time of rapid development of Australia and New Zealand. With the subsequent withdrawal of such assistance migration to Australasia declined rapidly and, notwithstanding the opening up of the gold-fields in Western Australia, the net migration during the 'nineties averaged no more than 4,000 per annum. It was not till well on in the first decade of the present century that there was again any considerable movement to Australia and New Zealand; in 1912 the record net outward movement of 80,000 persons was recorded. The net movement to the United States, and the total net outward movement with it, fell almost without a break from 1887 till 1894, and during the years of depression in this country and elsewhere which followed the financial crisis already alluded to, migration remained at a low ebb. After the conclusion of the South African war in 1901 there was a rapid increase in migration, in this case largely to Canada, leading to a peak of over 260,000 in both 1911 and 1912. It may be noted that while the large outward movement in the 'eighties was probably due in the main to emigrants (largely Irish) fleeing from distress or being urged on by the fear of distress, the movement in the twelve years before the war was due, to a much greater extent, to the prospect of getting on more rapidly elsewhere, and the increasing outward movement was entirely from Great Britain. These were also years during which, on the whole, the trade of this country was improving.

The conditions of post-war migration are essentially different from those of any earlier period, the economic factors which played so large a part in the movements during the preceding century are no longer allowed free play, and we have brought into being a new and powerful economic factor in the shape of social insurance.

II. FACTORS AFFECTING POST-WAR MIGRATION.

Effect on Migration of Schemes of Social Insurance.

In November, 1925, an Inter-Departmental Committee was appointed to consider "how far the existing provision for Old Age Pensions and for National Health and Unemployment Insurance tends to discourage migration from this country with a view to settlement in the Empire Overseas, and how far any such tendency will be accentuated by the Widows', Orphans' and Old Age Contributory Pensions Act; and in what manner any adverse effect resulting from such legislation can best be counteracted."

The Committee issued their report (Cmd. No. 2608) in February, 1926. The summary of their Conclusions and Recommendations states (pages 25 and 26 of the Report) :

“ The two chief causes which tend, at the present time, to discourage migration are (1) bad trade conditions and (2) the restrictions which the Dominion Authorities find it necessary to place on the grant of assisted passages. The cumulative effect of the various schemes of social insurance is believed to be a subsidiary one. These schemes have an effect in discouraging migration, both directly as a result of the sense of security they induce, and indirectly in that they raise the standards of living in this country, and so counteract to an appreciable extent the attraction of the life of independence offered in the Dominions. When openings in the Dominions are more varied and attractive, as they should become with improving trade conditions, if bolder and more comprehensive schemes of development and settlement could be undertaken, and if it were possible to modify the restrictions on assisted migration, and in particular to facilitate the migration of families and of women, social insurance legislation would have comparatively little effect in discouraging migration.”

The recommendations were :

- (a) Standardization of schemes of social insurance throughout the Empire should be considered by the next Imperial Conference.
- (b) Unemployment Insurance :—The attention of the Committee on the Administration of the Unemployment Insurance Acts be drawn to the attitude towards migration of persons approaching eighteen and for a few years thereafter.
- (c) Contributory Pensions :—All persons in receipt of pensions under contributory pension schemes should, on proceeding overseas as migrants, be credited with a years' pension in lieu of the pension which they will surrender on migration.
- (d) National Health Insurance :—The cost of the medical examination of persons insured under the National Health Insurance Act who make application for assisted passages should be provided from National Health Insurance Funds.
- (e) Publicity should be given to such social insurance schemes as exist in the Dominions.
- (f) Training :—That extended facilities should be provided for training juveniles in the elements of rural occupations.

Definite action has so far been taken only in respect of recommendation (c), but in regard to (d), following a recommendation of the Oversea Settlement Sub-Committee of the Imperial Conference adopted in 1927, the Canadian authorities decided to carry out the experiment of establishing in this country a

medical service by which prospective settlers were to be medically examined by Canadian doctors free of charge. As regards (c), the Contributory Pensions Act was amended, and since the beginning of 1930 persons intending to proceed overseas who were already in receipt of a pension under the Act could apply for the payment of their pension after arrival overseas. Persons who had been insured under the Act for two years or more could also, if they so desired, keep up their insurance so long as they remained in any part of the British Empire by becoming voluntary contributors under the Act. This amendment should assist, when times become more normal, towards removing any deterrent effect that the previous Act may have had on migration.

The Inter-Departmental Committee considered that the effect of these social schemes on migration was only subsidiary, but in our opinion it has been a relatively important factor tending to lead people to prefer the security at home to the uncertainty abroad, and the psychological effect of the social legislation in this country should not be under-estimated.

Assisted Migration.

The Committee of the Emigrants' Information Office tendered their resignation in December, 1918, and what is now known as the Oversea Settlement Committee (a sub-department of the Dominions Office) came into being. The free play of economic conditions upon migration ceased, and, as in so many other matters, settlement overseas started to be regulated by governmental machinery.

An advisory Committee was set up to keep in touch with the representatives of the Self-Governing Dominions and in April, 1919, the Government announced that ex-service men and women who had served in the war and who wished to settle within the Empire overseas might, with the consent of the Overseas Government concerned, obtain free passages for themselves and their dependants to the nearest convenient port to their destination, provided that they were approved under one of the agricultural schemes of the Overseas Governments, or were going to assured employment. Applications for free passages under this scheme were allowed up to the 31st December, 1921, and those approved were at liberty to avail themselves of the privilege of the scheme up to the end of 1922.

The approximate number of approved applicants and their dependants who sailed under the scheme up to and including the 31st December, 1922, was as follows :

TABLE III.

Country of Settlement.	Men.	Women.	Children.	Total.
Canada	11,539	7,522	7,499	26,560
Australia	16,514	8,316	9,923	34,753
New Zealand	5,467	3,391	4,032	12,890
South Africa and Rhodesia ...	2,688	1,777	1,429	5,894
Miscellaneous	991	666	442	2,099
Total	37,199	21,672	23,325	82,196

During 1920 favourable trade conditions gave place to unfavourable ones, and early in 1921 it became evident that the period of fictitious prosperity was over and that the consequent unemployment was to assume serious dimensions. The recommendations of a Conference with the representatives of Canada, Australia and New Zealand, held in the early part of 1921, resulted in the passing of the "Empire Settlement Act, 1922," in May, 1922. A transcript of this Act is given in Appendix I to the Overseas Settlement Report for 1931-32 (Cmd. 4143 of 1932).

It is not within the scope of this paper to follow the activities of the Committee under the Empire Settlement Act. The schemes approved under the Act have been many and various and have met with varying degrees of success; particulars of those in force at the

TABLE IV.

Assisted Emigration, 1922-30.

Sailings under Assisted Passage Agreements arranged under the Empire Settlement Act, 1922.

	To Australia.	To New Zealand.	To Canada.	(c) Total.
1922 (Sept. to Dec.)	5,611	688	180	6,479
1923	24,221	6,086	5,835	36,185
1924	23,645	7,750	9,609	41,044
1925	22,527	8,097	8,779	39,530
1926	32,689	11,795	20,862	65,544
1927	29,136	4,446	27,114	60,916
1928	20,603	2,175	24,890	47,856
1929	11,528	1,849	(b) 21,012	34,476
1930	1,978	1,312	(b) 8,145	11,509
Total (Sept. 1922 to Dec. 1930) (a)	171,938	44,198	126,426	(c) 343,539

- (a) The provisional figures for 1931 are: sailings to Australia 211; to New Zealand 421; to Canada 1,228; to all places, 1,921. Sailings to Canada under the £10 passage rate, 3,578.
- (b) Exclusive of 37,274 persons in 1929 and of 17,589 persons in 1930, who sailed under the £10 rate.
- (c) Includes 977 sailings in 1923-30 to South Africa and other parts.

end of each year are contained in the Annual Reports of the Oversea Settlement Committee. The results of the schemes, so far as emigration is concerned, are summarized in the following table. While this table shows the total number who emigrated with governmental assistance, it does not show the total number who took up permanent residence abroad. It is recorded, for example, that of the 8,449 men who were recruited in August, 1928, to go to Canada as harvest workers in the hope that they might ultimately become settlers, about 6,400 had returned to this country by the end of January, 1929.

The extent to which migration to the three above-mentioned Dominions has been dependent on assistance under the Act can be measured by comparison with the total number of British emigrants from the United Kingdom to those Dominions during the period specified. The figures are :

TABLE V.
British Emigrants to Australia, New Zealand and Canada.

	To Australia.	To New Zealand.	To Canada.	Total.
1922 (Sept. to Dec.) ...	14,079	4,251	13,677	32,007
1923	39,967	9,392	88,290	137,649
1924	38,599	11,061	63,016	112,676
1925	35,006	11,730	38,662	85,398
1926	44,513	16,565	49,632	110,710
1927	40,991	7,841	52,916	101,748
1928	28,714	4,975	54,709	88,398
1929	18,377	4,700	65,558	88,635
1930	8,517	3,981	31,074	43,572
Total (Sept. 1922 to Dec. 1930) (a)	268,763	74,496	457,534	800,793

(a) In 1931 the total number of British emigrants to these Dominions was 14,345, of whom 4,459 emigrated to Australia, 2,266 to New Zealand and 7,620 to Canada.

From a comparison of the figures shown in the two tables above it will be seen that, during the period September, 1922, to December, 1930, assisted migration under the Empire Settlement Act accounted for 43 per cent. of the aggregate emigration to the three Dominions specified. The numbers of assisted migrants to Australia represented about 63 per cent. of the total to that Dominion during the three years 1923, 1924 and 1925, over 70 per cent. during 1926 to 1928, and 50 per cent. in 1929-30. More than two-thirds of the total emigration to New Zealand during the four years 1923 to 1926 was assisted, but subsequently there was a progressive falling off in such

migration until in 1929-30 the proportion assisted was only 37 per cent. Sailings under the Act to Canada represented only 7 per cent. of the total in 1923, 15 per cent. in 1924 and 23 per cent. in 1925, but in 1927 they had increased to more than one-half of the total movement; the proportion declined to 46 per cent. in 1928 and in 1929-30 to less than 30 per cent. of the total, but in 1929-30 there were in addition to the assisted migrants some 55,000 persons who sailed under a special £10 passage rate arranged for intending settlers.

Considering the aggregate (up to the end of 1928) of approximately 300,000 assisted passages in relation to the possibilities under the Act, the report of the Oversea Settlement Committee for 1928 may be quoted :

“ It must be admitted that the results so far achieved have fallen far short of the hopes entertained by those who expected to find in oversea settlement a means of dealing with the immediate situation in this country. Such hopes are, in the opinion of the Committee, based upon an insufficient appreciation of the standpoint from which the problem is regarded by the Governments and peoples of the Dominions.”

That the number of sailings under the Act during the first three years of its operation was not considered to be wholly satisfactory may be inferred from the appointment in November, 1925, of the Inter-Departmental Committee to consider the effect on Migration of schemes of Social Insurance to which reference has already been made.

United States Immigration Restriction Laws.

After a century of unrestricted immigration the United States Government decided, soon after the close of the European war, to introduce a system of restricted immigration based on yearly quotas for the various countries concerned. So far as this country was concerned, the “ Per Centum Limit Law of 1921 ” fixed the quota for Great Britain and Ireland for the fiscal years ending 30th June, 1922, 1923 and 1924, at 77,342, this quota representing 3 per cent. of the persons of British and Irish nationality who were resident in the United States according to the 1910 Census. A new Immigration Restriction Act came into force on 1st July, 1924, under which quotas were based on 2 per cent. of the nationalities concerned according to the 1890 Census. This reduced the total for the British Isles to 62,574 (Great Britain and Northern Ireland 34,007 and the Irish Free State 28,567). A further change was made by the Immigration Restriction Act which came into force on 1st July, 1929, by

virtue of which the Great Britain and Northern Ireland quota was raised to 65,721 and that for the Irish Free State reduced to 17,853 (a total for the British Isles of 83,574); the latest Restriction Act changed the basis from one of "nationality" to one of "national origins" of the persons inhabiting the United States at the time of the 1920 Census, the 2 per cent. proportion being maintained. There was no change in the basis of persons counting against the quota so far as Great Britain and Northern Ireland were concerned.

The numbers of British and Irish immigrants admitted into the United States under the laws of 1921, 1924 and 1929, according to the Annual Reports of the Commissioners-General of Immigration, are shown in the following table :

TABLE VI.

United States : British and Irish Immigrants admitted and charged to Quotas, 1922-30.

Fiscal Year ending 30th June.	Quota, by Country of Birth.		Number of Immigrants admitted under Quota, by Country of Birth.	
	Great Britain and Ireland.		Great Britain and Ireland.	
1922	77,342		42,670	
1923	77,342		77,342	
1924	77,342		77,342	
	Great Britain and Northern Ireland.	Irish Free State.	Great Britain and Northern Ireland.	Irish Free State.
1925	34,007	28,567	29,710	27,125
1926	34,007	28,567	29,782	27,590
1927	34,007	28,567	28,257	31,566
1928	34,007	28,567	30,469	27,093
1929	34,007	28,567	30,442	19,341
1930	65,721	17,853	50,275	19,692

The above-mentioned quotas do not apply solely to emigrants direct from Great Britain and Ireland to the United States, but to British nationals generally, except (1) those included in the quotas of the Dominions and India, and (2) those exempt from inclusion in the quota by reason of being former residents in the United States, or husbands, wives or children of United States Citizens, or students, etc. Nationality for quota purposes does not always coincide with actual nationality.

The British subjects who were recorded in the Board of Trade passenger returns as leaving permanent residence in Great Britain and Ireland to reside permanently in the United States (emigrants) and sailing from ports in Great Britain and Ireland during the

period mid-June, 1922, to mid-June, 1930, numbered 487,000; deducting this number from the total number of immigrants admitted (549,000) there remains a balance of 62,000 immigrants in the nine years who were not recorded as sailing from ports in the British Isles. A large proportion of this balance consisted of workers who left their homes in Canada daily in order to cross into the United States and for whom a portion of the United Kingdom quota is allocated.

In the following table a comparison is made of the average number of immigrants admitted *annually* in the four decennia preceding the war, in the decennium 1921-30, and, for comparison, the average numbers charged against quotas in the first nine years (1922-30) during which the laws were operative. The figures are taken from the Reports of the Commissioner-General of Immigration.

TABLE VII.

Annual Average during Period (years ending 30th June).				Great Britain.	Ireland.	Total.
<i>Immigrants by country of Last Permanent Residence.</i>						
1871-1880	...	...	...	54,000	44,000	98,000
1881-1890	...	...	...	80,000	66,000	146,000
1891-1900	...	...	...	27,000	39,000	66,000
1901-1910	...	...	...	53,000	34,000	87,000
1921-1930	...	...	...	33,000	22,000	55,000
<i>Immigrants charged against the Quotas.</i>						
1922-1930	...	...	...	35,000*	26,000*	61,000

* Proportion estimated on the six years 1925-30.

Comparing the figures of total immigrants for the last two periods shown in the above table there was an average annual decline of about 32,000 in the number of immigrants from the British Isles; particulars of direct migration from the United Kingdom prior to 1st April, 1912, are not available from the passenger returns, but comparing the decennia 1901-10 and 1921-30 there was a decline of 39,000 in the average outward balance of British passengers from the British Isles to the United States.

As regards the present increased quota for Great Britain and Northern Ireland (65,721), it may be noted that the emigrants to the United States who sailed from ports in the United Kingdom, as recorded in the Board of Trade Returns, numbered only 9,155 and 1,871 respectively in the twelve months ended June 30, 1931 and 1932.

The average number of immigrants admitted into the United States

from the British Isles during the ten years ended 1930 was smaller than in any of the earlier decennia. During the twelve months ended 30th June, 1923 and 1924, there were many more people desirous of emigrating to the United States than could be admitted under the quota. Owing to the congestion in the autumn of 1923, during which period the quota immigrants from the United Kingdom for practically the whole of the fiscal year 1923-24 were allowed to depart to the United States, it was decided that the quota, as from 1st July, 1924, should be spread over the whole of the fiscal year, visas being given for not more than 10 per cent. of the total each month. This restriction doubtless had some effect on migration, and in no year subsequent to 1924 was the quota filled. Had it not been for the quota the total migration to the United States during the post-war years would certainly have been much larger.

Emigrants of British Nationality Rejected.

Certain information is available from Returns furnished voluntarily to the Board of Trade by the principal steamship companies with regard to the number of British subjects among those passengers from the United Kingdom to places outside Europe who were sent back by the authorities of the countries concerned. The total number of such deportations as recorded in these returns amounted to nearly 18,000 in the ten years 1921-30, or about one per cent. of the total number emigrating in that period. About two-thirds of the number were sent back from Canada and nearly all the remainder from the United States. Adult males and females represented about 64 and 20 per cent. respectively of the total, and children under 12 years of age about 16 per cent. These figures relate solely to British subjects brought back to the United Kingdom. The official Reports of the Commissioner-General of Immigration for the United States show a figure for the ten years 1921-30 of about 13,000 as the total number of English, Scottish and Welsh persons deported from the United States after landing, and a figure of about 47,000 as the number of such persons debarred from entering the United States.

The reasons given for the rejection or deportation of the majority of the persons from Canada and the United States were either that they were "paupers" or "likely to become a public charge," or criminals, or diseased or mentally afflicted, or that they had made an illegal entry into the country.

In the case of Canada, the Oversea Settlement Committee in their latest Report remarked on an increase from 2,892 in 1930 to 4,269 in 1931 in the number of migrants from the United Kingdom deported

on account of their becoming public charges, and said that this matter was receiving their careful consideration.

III. FEATURES IN POST-WAR MIGRATION.

Pre-war and Post-war Migration.

The annual averages of the net outward movement of British subjects from the British Isles to places outside Europe during the decennium 1921-30 are compared in the following table with corresponding figures for the ten years immediately preceding the war.

TABLE VIII.

	Balance Outward.		
	British Passengers (annual average 1904-13).	British Passengers (annual average 1921-30).	British Migrants (annual average 1921-30).
All places outside Europe	193,000	112,000	117,000
British Empire	129,000	76,000	74,000
All foreign countries	64,000	36,000	43,000
North America :			
British North America	93,000	42,000	43,000
United States	62,000	35,000	44,000
Australia and New Zealand	32,000	30,000	30,000

In the ten years ended 1913, the average number of British passengers leaving the British Isles for extra-European ports direct was about 359,000 a year. In the ten years ended 1930, the average annual number, including passengers from ports in Southern Ireland, had fallen to about 285,000, or by about one-fifth. The average number of British passengers arriving in this country by sea direct from extra-European ports was, in the decennium preceding the war, 166,000 yearly; in the ten years ended 1930 the number averaged 173,000. Thus the stream of passengers travelling to and fro on business or for pleasure and of our fellow-subjects coming from overseas residence to resume or take up life here, appears to have been more than maintained in volume, while the total outward movement has decreased. In 1931 the inward movement was 192,000, or about 10 per cent. more than the average for the preceding ten years, while the outward movement represented only 54 per cent. of the ten-year average. The outward balance fell from an average of 193,000 yearly in the ten years ended 1913 to an average of about 112,000 in the ten years ended 1930, or by over 40 per cent. For the five years 1926-30 the two series of figures show a net outward balance

of passengers averaging about 85,000 per annum from Great Britain and Northern Ireland and 14,000 from the Irish Free State.

The distribution of the emigration of the pre-war period between British Empire countries and foreign countries cannot be measured as accurately as the total volume of the movement. In the pre-war decennium, two-thirds of the balance of British passengers related to passengers travelling to and from ports in the British Empire. This proportion was substantially the same for the post-war decennium, 68 per cent. of the balance of British passengers being recorded in the like movement, while the figures relating to the countries of settlement show the slightly smaller proportion of 64 per cent. These figures appear to indicate that the numerical decrease in the net emigration from the British Isles has been divided between British and foreign countries in roughly equal proportions.

The net annual loss of 193,000 in 1904-13 consisted of 92,000 male and 68,000 female adults over 12 years of age and 33,000 children under 12 years of age, while the net annual loss of 117,000 British migrants in 1921-30 represented 57,000 male and 45,000 female adults respectively and 15,000 children. Thus adult males formed 48 per cent. of the total in both periods, whilst adult females and children under 12 years were 35 and 17 per cent. respectively to the total in the pre-war decennium, and 40 and 12 per cent. respectively in the later period.

Migration to Principal Non-European Countries.

The following summary statement furnishes a comparison of the Balance of Passenger Movement and the Balance of Migration from the United Kingdom in each year from 1921 to 1930, British nationals alone being considered in each case.

The net emigration of British subjects from the United Kingdom to non-European countries averaged about 122,000 per annum in the first half of the decennium 1921-30 and 95,000 per annum in the next four years, but in 1930 the figure had fallen to 26,000. The change from net emigration to net immigration is shown by the following table, which compares the movement quarter by quarter in the last three years with the average excess of British emigrants over immigrants in the corresponding quarters of the nine years 1921 to 1929.

The largest annual balance of British migrants in the decennium was recorded in 1923, when the net movement to both British North America and the United States was noticeably greater than in any other year. The practical exhaustion in the autumn of 1923 of the 1923-4 quota for the United States is shown in the high figure for 1923 and the very low one for the following year. The excess to

TABLE IX.

Balances of Passenger Movement (British Subjects) and of British Migrants, 1921-1930.

(Numbers in thousands.)

Years.	British North America.		Australia and New Zealand.		Total British Empire.		United States.		All Countries.	
	Passen- gers.	Mi- grants.	Passen- gers.	Mi- grants.	Passen- gers.	Mi- grants.	Passen- gers.	Mi- grants.	Passen- gers.	Mi- grants.
1921 ...	39	47	31	29	84	84	34	43	119	128
1922 ...	31	30	40	41	72	68	28	37	100	106
1923 ...	82	76	38	39	119	112	71	86	190	199
1924 ...	46	47	37	39	85	85	3	6	88	91
1925 ...	25	25	38	37	68	63	19	22	87	84
1926 ...	41	39	52	51	100	93	22	22	123	116
1927 ...	41	40	38	38	85	80	19	19	104	98
1928 ...	40	39	23	22	66	63	16	16	83	78
1929 ...	54	53	10	11	68	65	24	25	93	87
1930 ...	14	15	(a) 4	(a) 3	9	8	15	19	24	26
Total 1921- 1930	413	411	303	304	756	721	251	295	1,011	1,013

Note.—From 1st April, 1923, the figures are exclusive of passengers and migrants who departed from, or arrived at, ports in the Irish Free State; and from 1st October, 1923, the totals of migrants do not include those from or into the Irish Free State who travelled via ports in the United Kingdom.

(a) Balance inward.

Australia and New Zealand was greatest in 1926 but declined rapidly in the next three years, and in 1930 there was an excess of British migrants returning from Australia.

In 1931 and 1932 the inward stream of British subjects changing their permanent residence to this country exceeded those leaving to reside permanently overseas by 37,100 and 48,600 respectively, and

TABLE X.

Excess of British Emigrants over Immigrants.

Period.		Average of 1921-29.	1930.	1931.	1932.
First quarter ...	...	25,400	14,500	(a) 4,500	(a) 6,300
Second quarter ...	...	27,500	8,500	(a) 15,300	(a) 21,500
Third quarter ...	...	33,400	4,200	(a) 9,700	(a) 12,600
Fourth quarter ...	...	23,400	(a) 1,200	(a) 7,600	(a) 8,200
Year ...	...	109,700	26,000	(a) 37,100	(a) 48,600

(a) Excess of Immigrants over Emigrants.

during those years there was an inward movement from each principal country recorded.

The aggregate divergence in the ten years 1921-30 between the "balance outward" of British passengers and the net emigration as deduced from the information as to the past and future residence of passengers is found mainly in the traffic between this country and the United States, to which some reference has already been made, and between this country and the other parts of the British Empire not separately specified in the table (viz. British South Africa, India, Ceylon, and other British possessions in the Far East, West Indies, etc.). The "balance outward" to the United States was about 251,000, while the net emigration was recorded as 295,000, or 44,000 more. The bulk of the divergence (33,000) occurred in the first three years of the period covered, when the records may have been less accurate as regards the particulars of residence than in later years. But it should be noted that, as regards the later years, the substantial agreement is more apparent than real, the emigrants from the Irish Free State who travelled to the United States via this country being included among the passengers from the United Kingdom but not among the emigrants. The "balance outward" to the above-mentioned British Colonies and Possessions was about 42,000, while the net loss by migration was recorded as only 6,000. As regards the movement to and from India, Ceylon and the Far East in particular, the numbers are seriously affected by the lack of information regarding persons who travelled via ports in the Continent of Europe. It would appear that a larger number of British subjects coming to reside in this country for a year or more travel via the Continent than is the case with the reverse movement.

Sex, Ages and Occupations of Migrants.

The following table shows the number of British subjects recorded as emigrants from, or immigrants into, the United Kingdom in the ten years 1921-30, distinguishing children under 12 years of age, and males and females of 12 years of age and upwards, and also showing the division of the United Kingdom affected.

It appears from these figures that nearly 16 per cent. of the gross number of emigrants were children under 12 years of age, the proportion being nearly 17 per cent. for Scotland, 16 per cent. for England and Wales, and 11 per cent. for Northern Ireland. The proportion of children among the immigrants was rather more, representing 18 per cent. of the total number, with no great divergence in the proportionate numbers into the three divisions of the United Kingdom.

Of those of 12 years of age and upwards the numbers of male and

TABLE XI.
Aggregate Numbers, 1921-30.
(Numbers in thousands.)

British Subjects.	Emigrants.				Immigrants.			
	Of 12 years and upwards.		Under 12 years of age.	Total.	Of 12 years and upwards.		Under 12 years of age.	Total.
	Males.	Females.			Males.	Females.		
From or to :								
England and Wales	471	394	165	1,030	196	200	88	484
Scotland ...	201	170	75	446	42	37	19	98
Northern Ireland*	79	75	19	173	12	11	5	28
Total United Kingdom* ...	751	639	259	1,649	250	248	122	610

* The figures are inclusive of emigrants from, and immigrants into, the whole of Ireland prior to 1925; the numbers of emigrants from, and immigrants into, the Irish Free State during the period April 1, 1923, to December 31, 1924, were approximately 30,000 and 4,000 respectively.

of female immigrants were about equal, while males exceeded females in the outward movement in the proportion of about 117 : 100.

The net excess of emigration over immigration in the decennium, as shown in the table above, was 1,039,000. The age groups into which the migrants have been classified since 1921 is shown below :

TABLE XII.
Aggregate Numbers—Emigrants and Immigrants, 1921-30.
(Numbers in thousands.)

Ages at last Birthday.	Emigrants.		Immigrants.		Excess of Emigrants.	
	Males.	Females.	Males.	Females.	Males.	Females.
Under 12 years ...	130	126	54	53	76	73
12 to 17 years ...	84	52	11	12	73	40
18 to 20 years ...	80	55	11	8	69	47
21 to 25 years ...	188	120	37	27	151	93
26 to 30 years ...	134	122	44	43	90	79
31 to 45 years ...	188	193	88	94	100	99
46 years and over ...	77	95	60	65	17	30
Total* ...	883	766	306	304	577	462

* Inclusive of a small number (12 years of age and over) whose ages were not specified.

Of the "adults" of 18 years of age and upwards there was shown in the ten years a net emigration numbering about 427,000 males

and 350,000 females, 51 per cent. of the former and 40 per cent. of the latter being between 18 and 25 years of age; those aged 31 years and over represented 27 per cent. of the adult males and 37 per cent. of the adult females. The proportion of children under 12 years of age to the total excess number of male and female emigrants was 13 and 16 per cent. respectively for male and female children, the corresponding proportions for juveniles aged 12-17 years being 13 and 9 per cent. respectively.

In the year 1931 the number of male emigrants was 15,010, while the number of male immigrants was 23,728 more. Of this excess 45 per cent. were of 31 years of age and over, and 16 per cent. were children under 12 years of age. Female emigrants in the same year numbered 19,300 and female immigrants 32,644; 52 per cent. of the excess of immigrants over emigrants were of 31 years of age and over and 26 per cent. were children under 12 years of age.

As might be expected, the average age of the immigrants considerably exceeded that of the emigrants. In the ten years 1921-30 60 per cent. of the total number of male and female adults (18 years and upwards) returning to the United Kingdom were over 30 years of age as compared with under 45 per cent. for emigrants.

Commencing with the year 1921 the occupations recorded as followed by British adult emigrants and immigrants have been classified in ten groups for males and six groups for females, the minimum age for an adult worker being taken as 18 years. The summary table (XIII) shows the aggregate numbers of British male and female migrants of 18 years and upwards who left or took up permanent residence in the United Kingdom,* according to their class of occupation, during the ten years 1921-30.

The number of adult male emigrants from the United Kingdom whose occupations were returned as agricultural exceeded the number of any other group in the classification, being 21 per cent. of the total males of 18 years and upwards. The next largest number in any individual group was shown in respect of the male emigrants whose occupations were recorded as commercial, finance and insurance, this group accounting for 15 per cent. of the total. In the metal and engineering group the numbers represented 14 per cent. of the total, and taking the aggregate of the four groups which are included under the heading of skilled trades, the proportion to the total was about one-third.

In each year of the decennium the proportion of the total number of male emigrants classed as "agricultural workers" and as "labourers not in agriculture or transport" was higher from Ireland than from Great Britain; in mining and quarrying, and in the metal and

* Including all Ireland prior to 1925.

TABLE XIII.
Aggregate Numbers, 1921-30.
 (Numbers in thousands.)

Classes of Occupation.	Emigrants.	Immigrants.
Males :—		
Agricultural	141	27
Commercial, finance and insurance	100	45
Professional	35	28
Skilled trades :—		
Mining and quarrying	43	10
Metal and engineering	91	30
Building	15	5
Other	72	26
Transport and communications	26	10
Labourers not in agriculture or transport	72	18
Other and ill-defined occupations	74	42
† Total, 18 years and over	669	241
Females :—		
Domestic, Hotel, etc. service	154	32
Commercial, finance and insurance	35	9
Professional	33	19
Clothing trades	15	3
Wife or housewife (not otherwise described)	276	130
Other and ill-defined occupations	75	45
† Total, 18 years and over	588	238

† Inclusive of a small number of migrants of 12 years of age and over whose ages were not specified.

engineering groups, the proportion from Scotland was the highest (particularly in the heavy movement to the United States in 1923), and in the commercial, finance and insurance group the proportion from England and Wales was the largest.

Of the 669,000 male emigrants of 18 years and upwards, 483,000 (or 72 per cent.) went to places within the Empire; more than one-quarter of this number (124,000) were returned as agricultural workers, while skilled workers of all kinds aggregated 142,000, or nearly 30 per cent. of the total to Empire countries. The number of adult male emigrants to foreign countries was 186,000, the great majority going to the United States; 79,000, or 42 per cent. of this number were recorded as skilled workers, and those returned as agricultural formed less than 10 per cent. of the total.

Of the female emigrants, the proportion of wives or house-wives (not otherwise described) was about 47 per cent., and the proportion employed in domestic, hotel, etc. service was about 26 per cent. The numbers in the commercial, finance and insurance, and professional groups each represented about 6 per cent. of the total.

In the return movement of adult males to the United Kingdom the largest number in any individual group was recorded in "commerce, finance and insurance" (19 per cent. of the total), while among adult females, wives or housewives (not otherwise described) accounted for 55 per cent.

The proportion of the adult males between the ages of 18 and 30 to the total number of adult males emigrating was more than 70 per cent. of those employed in agriculture and of labourers other than those engaged in agriculture or transport; in the four skilled trades groups those between 18 and 30 years of age amounted to about 60 per cent., and of those included in the commerce, finance and insurance group to rather less than 60 per cent. Those adult emigrants classified as professional were about equally divided between those under and over 30 years of age. Among female emigrants, domestic servants and clerical workers between the ages of 18 and 30 years accounted for over 70 per cent. of the total shown in those occupational groups, while about two-thirds of the wives or housewives were over 30 years of age.

The following table shows the numbers of male and female adults emigrating from the United Kingdom to non-European countries in each year from 1921 to 1931 :

TABLE XIV.
British Emigrants to non-European Countries.
(Adults of 18 years and upwards.)

	Males.	Females
1921	73,205	81,522
1922	70,272	65,753
1923	130,188	82,721
1924*	58,903	55,493
1925	51,799	51,242
1926	64,636	57,178
1927	60,741	52,918
1928	57,552	45,678
1929	57,101	50,713
1930	34,531	37,314
1931	10,865	15,614

* From 1924 onwards the figures relate to Great Britain and Northern Ireland.

It will be seen that except in the years 1921, 1930 and 1931 there was an excess of male over female adult emigrants. In 1921 the excess of 8,317 females occurred in the movement to the United States (7,107) and British North America (1,492) and may be traced in part to the unusually large number of domestics emigrating from

Ireland to the United States in that year, while of the wives and dependants of members of Overseas Forces there may have been a residuum returning to their own countries, the members of the Forces themselves not normally travelling as ordinary passengers. The excess in the years 1930 and 1931 may perhaps be attributed to the relatively greater decline, in a period of acute depression, in the numbers of male labourers and artisans than in those of families, though it may be observed that the numbers of domestics emigrating showed almost as heavy a relative decline as any occupational group. The excess in 1931 was spread over all the principal countries recorded.

Family Emigration.

In the Passenger Returns a column is provided in order that the ages of the passengers may be shown, and for administrative purposes in connection with the accommodation provided on the vessel this column is sub-divided to show "adults of 12 years and upwards," "children between 1 and 12," and infants. The "adults" are grouped according to whether they are "accompanied by husband or wife" or not. From these particulars it has been possible to extract the information as to family emigration from the United Kingdom shown in the table on p. 208, the pre-war and post-war years selected for this purpose being 1913 and 1929.

The table shows that family emigration (*i.e.* the total number of children and of the parents accompanying them) represented about 35 per cent. of the total number of British emigrants in both 1913 and 1929. Considering the totals of families accompanied by one or both parents, out of every 100 persons parents averaged 39 in 1913 and 42 in 1929, children over 17 years 6 in both periods, juveniles of 12 to 17 years 8 in 1913 and 11 in 1929, and children under 12 years 46 in 1913 and 41 in 1929. The number of fathers and mothers who emigrated together with their children in 1929 represented 44 per cent. of the number in 1913, but the corresponding proportion for the mothers or fathers emigrating with their families was much less, *viz.* 33 per cent.

In both the pre-war and the post-war year families which were accompanied by *both* parents represented on the average father, mother and two children, the proportion per 100 being parents 48 and children 52. Of the families accompanied by *one* parent only the numbers in 1913 showed an average family of one parent and two children, but in 1929 the average number of children per parent was about 1.8. Children under 12 years of age, whether accompanied by one or both parents, were three times more numerous than children above 12 years in 1913, while in 1929 the younger children in each group were about two and a half times more numerous than the

TABLE XV.
British Emigrants to Non-European Countries.

(Numbers in thousands.)

	1913.			1929.		
	North American Continent.	Australia and New Zealand.	All Places.	North American Continent.	Australia and New Zealand.	All Places.
FAMILY EMIGRANTS :						
Children accompanied by both parents :						
Parents	19.3	7.4	28.5	8.6	2.5	12.4
Children, aged over 17	2.3	0.9	3.2	0.8	0.3	1.2
„ aged 12-17...	2.9	1.3	4.4	2.0	0.5	2.7
„ under 12 ...	15.7	6.3	23.3	7.2	1.8	9.8
Total	40.2	15.9	59.4	18.6	5.1	26.1
Children accompanied by one parent :						
Parents	18.1	5.5	25.5	5.5	1.3	8.4
Children, aged over 17	4.1	1.2	5.7	1.3	0.4	1.9
„ aged 12-17...	4.4	1.9	6.6	2.1	0.5	2.8
„ under 12 ...	27.5	9.2	39.5	6.9	1.4	10.3
Total	54.1	17.8	77.3	15.8	3.6	23.4
Total of above :						
Parents	37.4	12.9	54.0	14.1	3.8	20.8
Children, aged over 17	6.4	2.1	8.9	2.1	0.7	3.1
„ aged 12-17...	7.3	3.2	11.0	4.1	1.1	5.5
„ under 12 ...	43.2	15.5	62.8	14.1	3.2	20.1
Total	94.3	33.7	136.7	34.4	8.7	49.5
<i>Total number of Emigrants</i>	<i>285.5</i>	<i>71.0</i>	<i>389.4</i>	<i>96.3</i>	<i>23.1</i>	<i>143.7</i>

older children, there being an increased proportion of juveniles aged 12 to 17 years in the later year.

The North American Continent accounted for about 70 per cent. of the total family emigration in 1913 and 1929, but the numbers to Australia and New Zealand, which represented 25 per cent. of the total family emigration in 1913, fell to 17 per cent. in 1929.

Migration Movement to and from the Irish Free State.

The British emigrants from and immigrants into the Irish Free State who travelled to or from non-European countries via ports in the United Kingdom numbered 44,338 and 7,940 respectively in the seven years 1924-30.

In addition to the above-mentioned migrants, account must be taken of British emigrants embarking or arriving at ports in the

Irish Free State, the great majority of whom are in course of leaving or taking up residence in the Irish Free State. During the period 1924-30 these emigrants numbered 123,812 (of whom 115,753 were for the United States) and the immigrants 7,472 (including 6,338 from the United States).

It will thus be seen that the total emigration of British subjects from the Irish Free State during 1924-30 amounted to about 168,000 persons, while the return movement of persons recorded as changing their permanent residence was only about 15,000. In 1931 the emigrants numbered 1,462 and the immigrants 3,407, the inward movement being somewhat larger than in previous years.

Alien Emigrants and Immigrants.

The balance outward in the decennium 1921-30 of alien passengers in the movement between the United Kingdom and non-European countries was 342,000, all but 4,000 of this number consisting of aliens passing through the United Kingdom in transit to other countries. It may, therefore, be assumed that the streams of aliens travelling via this country from Europe to non-European countries and vice versa were of approximately the same size and made no measurable addition to, or reduction from, the alien population of the United Kingdom.

As regards aliens leaving or taking up residence in this country, the returns for the ten years 1921-30 show that the 26,425 aliens who left permanent residence in the United Kingdom to take up permanent residence in countries outside Europe were approximately replaced by the 26,101 aliens who were recorded as leaving permanent residence in such countries to take up permanent residence in the United Kingdom. Of the alien emigrants and immigrants from or to the United Kingdom about 57 per cent. were shown as changing their permanent residence to or from the United States and 30 per cent. to or from other foreign countries.

IV. PASSENGER MOVEMENT TO ALL COUNTRIES.

In considering the effect on the population of the United Kingdom which may be attributed to migration, account must be taken of the net passenger movement (British subjects and aliens) to and from the Continent of Europe, as well as the balance of passengers to or from non-European countries. The table on p. 210 shows the total numbers of passengers of all classes and nationalities who landed or embarked at ports in the United Kingdom by sea in each year from 1921 to 1932, with the exception of members of ships' crews, persons who travelled on private vessels, and those on military or

TABLE XVI.

(Numbers in thousands.)

Passengers of all Nationalities.	1921.	1922.	1923	1924.	1925.	1926	1927	1928	1929.	1930	1931.	1932.
Outward Passengers :—												
To countries out of Europe	378	343	463	371	355	402	414	397	399	328	213	222
To European countries (a)	830	904	1,045	1,140	1,239	1,264	1,308	1,454	1,468	1,505	1,358	1,034
To Irish Free State	(b)	(b)	(b)	323	338	300	333	351	364	363	370	367
Total to all countries ...	1,208	1,247	1,508	1,834	1,932	1,966	2,055	2,202	2,231	2,196	1,941	1,623
Inward Passengers :—												
From countries out of Europe	228	224	210	253	241	237	260	277	278	290	256	277
From European countries (a)	855	923	1,111	1,183	1,269	1,313	1,387	1,516	1,526	1,550	1,400	1,048
From Irish Free State	(b)	(b)	(b)	336	348	316	354	362	376	372	376	375
Total from all countries ...	1,083	1,147	1,321	1,772	1,858	1,866	2,001	2,155	2,180	2,212	2,032	1,700
Balance Outward or Inward :—												
Outward to countries out of Europe	150	119	253	118	114	165	154	120	121	38	43	55
Inward from European countries (a)	25	79	66	43	30	49	79	62	53	45	42	14
Inward from Irish Free State	(b)	(b)	(b)	13	10	16	21	11	12	9	6	8
Outward to all countries	125	100	187	62	74	100	54	47	51	(c) 16	(c) 91	(c) 77

Note.—The figures of the movement to and from countries out of Europe for the last nine months of 1923 and for subsequent years are exclusive of passengers who departed from, or arrived at, ports in the Irish Free State.

(a) Passengers to and from all ports on the Mediterranean and Black Seas are included with passengers to or from European countries.

(b) Statutory Returns were not furnished before 1924.

(c) Balance inward.

naval service; particulars for 1922-32 of the numbers of passengers reported by the Air Ministry as travelling to or from the Continent of Europe by air are also included.

Aggregate Movement.

The aggregate number of passengers (outward and inward) travelling between the United Kingdom and countries out of Europe in the ten years 1921-30 averaged about 635,000 annually, the greatest number in any year being 677,000 in 1929. There was a fall of 59,000 in 1930 as compared with 1929, and a further fall of 149,000 in 1931. The increased numbers travelling on pleasure cruises caused a rise in 1932. The aggregate passenger movement to and from non-European countries averaged 851,000 annually in the ten years 1904-13, and the number exceeded 1,000,000 for the first time in 1913. The pre-war aggregates are, of course, inclusive of the movement between non-European countries and all ports in Ireland, but adding in the movement between the Irish Free State and non-European countries, the post-war average is only increased to 665,000. Of the total of passengers to and from non-European countries, those travelling between the United Kingdom and North America (United States and British North America) formed 66 per cent. in the decennium 1921-30 and 79 per cent. in the ten years 1904-13. The aggregate movement to Australia and New Zealand represented 11 per cent. of the total in the later period and 7 per cent. in the earlier.

The total of passengers to and from the Continent of Europe exceeded 2 millions for the first time since the war in 1923, exceeded 2½ millions in 1926 and 3 millions in 1930, as compared with a figure a few thousand short of 2½ millions in 1913.

Included in the post-war figures are the numbers of passengers travelling to and from the Continent *by air*. As reported by the Air Ministry the numbers of such passengers in the years for which information is available were as follows:

TABLE XVII.

Year.	To the Continent.	From the Continent.	Total.	Year.	To the Continent.	From the Continent.	Total.
1922	5,500	6,500	12,000	1927	14,000	15,000	29,000
1923	6,500	8,500	15,000	1928	21,000	22,500	43,500
1924	8,500	9,500	18,000	1929	23,500	25,000	48,500
1925	9,500	11,000	20,500	1930	20,500	22,500	43,000
1926	12,500	13,000	25,500	1931	22,500	24,000	46,500
				1932	35,300	36,300	71,600

It will be seen that the movement grew steadily from 1922 to 1929, but there was some falling-off in 1930. In 1931, however, in spite of the 10 per cent. reduction in the aggregate numbers travelling to and from the Continent by sea and by air, the number travelling by air increased by about 3,500, and in 1932 the total was some 23,000 more than in 1929. As was the case in the numbers travelling to and from the Continent by sea, the arrivals in this country by air were in each year more numerous than the departures, but as regards the excess of arrivals by sea from the Continent, it may be noted that there was an excess of departures by sea to other parts of the world in each year from 1921 to 1930.

The aggregate movement to and from the Irish Free State by sea averaged 691,000 annually in the period 1924–30, the decrease of 70,000 in 1926, as compared with 1925, being attributable to the interference with transport facilities in May, 1926, and to the subsequent difficulties caused by the continuance of the coal dispute.

Balance of Passenger Movement.

The excess of outward over inward passengers of all nationalities in the movement to and from non-European countries amounted to about 1,350,000 in the decennium 1921–30, whilst the excess inward from European countries in the same period amounted to about 476,000. The inward balance of passengers into the United Kingdom from the Irish Free State, based on the particulars available for the period 1924–30, may be estimated at about 125,000, excluding any movement over the land boundary. The relating of figures representing streams of traffic of different magnitudes and based on records of varying degrees of accuracy is open to serious objection. From the above-mentioned data it may, however, be deduced that the net loss to the United Kingdom by civilian migration during the ten years 1921–30 was approximately three-quarters of a million. As regards the movement of non-civilians (*i.e.* naval, military and air force), it may be estimated, from the material available, that establishments overseas had been reduced in the ten years by between 60,000 to 70,000. The Preliminary Reports on the 1931 Censuses of England and Wales, and of Scotland, are now available and the balances representing the excess of emigration over immigration (all types) from those countries is indicated by the excess of the natural increases over the net increases during the inter-censal period (*i.e.* from June 19–20, 1921, to April 26–27, 1931). These figures show a net emigration of all nationalities from England and Wales of 177,000 and from Scotland of 392,000. The net movement from Northern Ireland cannot be measured by this method, as its population was enumerated with that for the whole of Ireland

in 1921 and a Census was not taken in 1931. The net migration of British subjects to non-European countries from Northern Ireland (and for all Ireland prior to October 1, 1923) as measured by the Board of Trade Returns, was about 103,000 in the inter-censal period 1921-31. It will thus be seen that, notwithstanding the limitations in the passenger movement records, the net migration from the United Kingdom of rather less than 700,000 in the decennium 1921-30, as measured by those records, differs by under 2 per cent. from the net loss by migration as measured by the population changes recorded at the respective Censuses of Population.

Alien Passengers.

The passengers who left ports in the United Kingdom in the ten years 1921-30 for countries out of Europe included 1,150,000 aliens. and 3,208,000 of those who left for continental ports were also recorded as aliens. Among passengers who arrived from extra-European countries direct by sea, 808,000 were aliens, and 3,546,000 of the passengers from the Continent of Europe were also so described in the returns made to the Home Office. The net movement, as measured by the returns, shows therefore an excess outward of about 4,000 aliens from this country in the period mentioned.

In considering the foregoing figures, however, it should be noted that passengers making the double journey between a non-European country and this country will be included in each set of statistics in one direction only (*i.e.* on arrival or on departure, but not both) if the journey in one direction is made direct and that in the other direction indirect, via the Continent and using a cross-Channel vessel. This would be the case, for example, with tourists from the United States who land in France, subsequently cross to the United Kingdom (being then reckoned as "Continental" passengers), and finally return to America direct from this country.

According to the returns furnished to the Home Office, in the ten years 1921-30, about 394,000 alien transmigrants passed through the United Kingdom *en route* from Europe to places out of Europe, and about 130,000 alien transmigrants were recorded in the reverse movement.

British and Alien Passengers Travelling for Business or Pleasure.

A large number of British subjects usually resident in other parts of the British Empire, or in foreign countries, are included in the total of passengers arriving or departing. The average number per annum of British passengers to non-European ports in the ten years 1921-30 was 270,000 and the arrivals from those ports 169,000.

Deducting from these totals the number of those who are shown as migrating from or to the United Kingdom or the Irish Free State, the British subjects who may be regarded as travelling for business or pleasure to or from countries out of Europe averaged 105,000 per annum outward and 108,000 per annum inward. In a similar manner the deduction of the numbers of alien transmigrants and migrants from the total numbers of alien passengers to or from non-European countries shows that alien subjects who may be regarded as travelling from or to the United Kingdom for business or pleasure averaged 73,000 per annum outward and 65,000 per annum inward. Passengers, outward or homeward, who travelled indirectly via ports on the Continent or via ports of the Irish Free State, are not included in these aggregates.

TABLE XVIII.
Passengers Travelling for Business or Pleasure.
(Numbers in thousands.)

Year.	To non-European Countries.			From non-European Countries.		
	British Subjects.	Aliens.	Total.	British Subjects.	Aliens.	Total.
1921	69	48	117	78	43	121
1922	74	63	137	80	54	134
1923	80	61	141	89	51	140
1924	108	71	179	111	65	176
1925	102	76	178	106	66	172
1926	110	73	183	109	66	175
1927	117	88	205	117	76	193
1928	128	82	210	128	77	205
1929	132	86	218	131	78	209
1930	125	81	206	130	80	216
Annual Average 1921-30 ...	105	73	178	108	65	173
1931	114	56	170	112	57	169
1932	138	*	*	138	*	*

Not yet available.

The table shows clearly the steady increase from 1921 to 1929 in the number of British and also of alien passengers travelling for business or pleasure between this country and countries outside Europe. There was a slight falling off in 1930 and a larger one in 1931, the decrease affecting aliens to a greater extent than British subjects. The inward and outward movement of British passengers in 1931 was, however, greater than in any post-war year prior to 1927. The estimated number of British subjects travelling for

business or pleasure to non-European countries in 1932 is higher than the number recorded for any post-war year. This increase was due to the increased number of vessels engaged in pleasure cruises, the number of non-migrants travelling on other vessels being about the same as in the previous year. The number of persons travelling on pleasure cruises to places out of Europe in 1932 was about 36,000, or some 25,000 more than in 1931, and about 57,000 passengers took part in 1932 in pleasure cruises to the Mediterranean and to European ports.

A sample investigation of the British passengers other than emigrants travelling outwards to non-European countries in three months of 1932 shows that about 42 per cent. were visitors to this country from other British countries, 16 per cent. were visitors from foreign countries, while 34 per cent. were residents of this country. The remainder consisted mainly of transmigrants or of persons travelling from a British or foreign country with the intention ultimately of taking up permanent residence here. In March the number of British visitors returning home to foreign countries was small and the number returning to British countries was about equal to the number of United Kingdom residents visiting countries out of Europe. In June the last-named class formed nearly two-thirds of the total, while in September there was a relatively large outward movement of British visitors from foreign countries and the visitors returning home to British countries formed over half the total.

Class of Travel.

Separate particulars of the class of travel of emigrants and immigrants, as distinct from other passengers, are not collected, but it may be of interest to show how passengers to and from countries out of Europe were divided with reference to the classes by which they travelled.

Though in the post-war period the number of outward passengers travelling first and second class was much greater than in the reverse movement, the proportion which these passengers represented of the total movement was appreciably smaller in the outward than in the inward direction. As compared with the six years preceding the war, an increased proportion of the passengers, both inward and outward, travelled first-class in the post-war period, and there was also an increase in the proportion of second-class passengers travelling to this country, but no change in the proportion travelling outwards. The proportion of passengers travelling third-class was considerably smaller in 1921-30 than in the pre-war period, the decrease in the proportion being larger for inward than for outward passengers.

TABLE XIX.
Passengers to and from Non-European Countries.

(Numbers in thousands.)

Year.	Outward Passengers.				Inward Passengers.			
	First Class.	Second Class.	Third Class.	Total.	First Class.	Second Class.	Third Class.	Total.
1921	76	116	186	378	67	70	91	228
1922	76	112	155	343	68	79	77	224
1923	80	137	246	463	72	75	63	210
1924	86	111	174	371	77	88	88	253
1925	87	103	165	355	77	75	89	241
1926	85	91	226	402	75	67	95	237
1927	90	89	235	414	82	66	112	260
1928	89	83	225	397	82	69	126	277
1929	90	81	228	399	82	67	129	278
1930	80	70	178	328	75	65	150	290
Total	839	993	2,018	3,850	757	721	1,020	2,498
Per cent. ...	22	26	52	100	30	29	41	100
1908-13* ...								
Per cent. ...	16	26	58	100	25	24	51	100

* Prior to 1st January, 1908, less complete information as to class of travel was obtained.

Note.—The figures for the last nine months of 1923 and for subsequent years are exclusive of passengers who departed from, or arrived at, Irish Free State ports.

During 1925 a class of travel entitled "Third-Class Tourist" was instituted, accommodation superior to that for ordinary third-class passengers being provided for passengers so described. From 1928 onward, however, the tourist-class accommodation was improved, and in many cases it replaced second-class accommodation. The numbers of inward and outward passengers reported as travelling in the class were :—37,000 in 1926, 78,000 in 1927, 91,000 in 1928, 105,000 in 1929, 118,700 in 1930, 95,400 in 1931, and 154,000 in 1932. The numbers for 1926-30 are included in the table above with third-class passengers. The third-class tourist services operated mainly between the principal English and Scottish ports and North America, but recently there has been a development in the tourist services to other parts of the world. The increased popularity of this class of travel has been reflected in the decreased numbers travelling second-class in the years mentioned as compared with the figures for the first half of the decennium. The increase in the numbers recorded as travelling in the tourist class in 1932 is primarily due to the inclusion in this class in this year of the bulk of the passengers travelling on pleasure cruises.

Conclusion.

As is the case with many other social problems, the after effects of the war altered considerably the overseas settlement of population from these Islands. The unrestricted emigration of individuals by their own efforts gave place to selective and restricted migration. Of the aggregate of 800,000 British emigrants to the Dominions of Canada, Australia and New Zealand from September, 1922, to December, 1930, about 344,000 took advantage of the assistance which the Governments of this country and of the Dominions provided. This number might have been substantially greater in the period 1924-29 if the physical or other standards required by the Dominions had not been so high. Some of the causes leading to a restriction of Empire settlement have been the industrial habits and the townward bent of the general population of this country, their improved standard of living and the cumulative effect of the various schemes of social insurance; the high cost of ocean travel; and the ability of the Dominions to absorb new arrivals in employment being mainly restricted to agricultural work for men and domestic service for women. Outside the Empire the United States Government decided in 1921 on a policy of restricted immigration. The reduction of post-war emigration from this country to the United States to a smaller average for the ten years ended 1930 than for any of the pre-war decennia for which information is available, and by about 26,000 annually compared with the average for 1901-10, may be attributed mainly to this action of the United States. The total reduction in the volume of net migration from the British Isles in the decennium 1921-30 as compared with that in the ten years 1904-13 was more than 40 per cent. In the last two years the normal movement has been reversed, and the number of British subjects immigrating into the United Kingdom from non-European countries exceeded those emigrating by about 37,000 in 1931 and 49,000 in 1932.

What is likely to be the volume of migration in the future? That the people of this country are most ready to undertake the adventure of migration when times are prosperous, and least ready when they are depressed, was the opinion expressed by Sir Robert Giffen as long ago as 1885, and there is no sound reason to suppose that this factor will not continue to have some influence on the volume of emigration in the future. That it may not be allowed to have as full play as in the days before the war may be gathered from the foregoing survey of the conditions under which emigration has been taking place since the war. And unless the Dominions adopt social legislation on the same lines as our own, there is likely in the future to be less desire

to emigrate than in times past. The influence of social legislation in this country on the volume of migration, it may be noted, assumes greater importance in times of depression than in times of prosperity. Some further action seems called for to minimize the effect of this factor, and it is suggested that it might be found possible to arrange for the capitalized value of the contributions paid to be placed to the credit of suitable applicants. The ability to emigrate with some capital is probably a main reason why emigration tends to attain its greatest volume when the economic conditions in this country are good.

Some of the largest movements in the past have taken place when there was a different level of prosperity in these Islands and in the United States or the Dominions, either when as in the 'forties the conditions in Ireland were so bad that people struggled to go anywhere overseas where there was some chance of doing better, or in later years when in the rapid development of new lands there were greater opportunities for success overseas than at home. With the greater interdependence of countries on one another under modern conditions, such markedly different levels of economic prosperity are less likely in the future to persist for any length of time, though the relative level of prosperity in this country and elsewhere will doubtless have some influence in determining the volume of migration.

The following extract taken from an article "Migration in 1931," which appeared in the August, 1931, number of *The Oversea Settler*, a Bulletin issued by the Oversea Settlement Department, may be considered as representing the view of that Department regarding the present slump in migration from this country.

"If, however, the causes of the present slump in migration are understood, there is no reason for pessimism as to the future. In the first place, it should always be remembered that migration goes hand in hand with prosperity. Secondly, whatever may be the continental view of migration, as a 'safety-valve' for undue pressure of population, our view, radically different, is that it implies a continual, a progressive and economic redistribution of population throughout the Empire, carefully regulated to meet current conditions and requirements.

"There is little ground, therefore, for surprise—and still less for alarm—if in this period of world-wide trade depression migration has of its own accord sunk to so low an ebb. Nor can we expect that, while the depression continues, the oversea Dominions will encourage the inflow of new population. Their main preoccupation at present, and rightly so, is to solve their

own economic problems and thus to provide jobs for their own people. It must not be thought, however, that because the Home and Oversea Governments have agreed for the present drastically to curtail assisted migration, any embargo has been placed upon immigration from the United Kingdom to the Dominions. There is nothing to prevent the independent movement of people of the right type from one part of the Empire to another, provided that they can pay their own way and maintain themselves on arrival overseas. But the Dominions will not *encourage* settlers when to do so would merely add to their difficulties and might mean failure, and hardship, for the settlers themselves. Nor is it advisable for our people to go unless they know beforehand that there are satisfactory prospects of their earning a livelihood.

“This depression, heavy though it is, must in the nature of things give way to prosperity, as has happened in past times. And we may be sure that when trade conditions improve, or, in other words, when a price more closely related to the cost of production can be obtained for the primary or staple products of our Dominions, and when their economic progress is resumed, so will the flow of migrants begin to swell from the trickle of to-day, until it again becomes a broad stream.”

It may be assumed therefore that, with the return of a period of prosperity to the Dominions overseas, the maintenance of a flow of emigration from this country will, at least for some years to come, form a part of Governmental policy.

That harm is done to the emigration policy of this country by the direct association of this question with a solution of our unemployment problem appears probable; so far from dumping our undesirables on the Dominions it appears more likely that they have withdrawn some of the best labour from this country. With the numbers of unemployed at present approximating $2\frac{3}{4}$ millions, it seems a far cry to the time when the extent to which population can be released for settlement overseas may be a matter of concern to the mother country. This aspect of the question, however, cannot be overlooked, as in matters of migration policy it is necessary to take the long view.

Commenting on the enormous reduction in the number of births in England and Wales during the past ten years, the Registrar-General states in his Preliminary Report on the 1931 Census (page xi):

“The full significance of the fall will be but dimly appreciated for many years to come: any temporary satisfaction felt in a reduction of the number of unproductive mouths to be filled

during the present period of economic stress must sooner or later be qualified by a realization of the profounder secular issues involved. The births of to-day govern the population of the future; and just as the nation which faced the upheaval of 1914 to 1918 was the product of the birth-rates prevailing towards the close of last century, we are now observing the conditions which will shape the generations charged with the national destiny in the latter part of the present century."

Similarly the Registrar-General for Scotland observes in his Preliminary Report on the 1931 Census that the natural increase in 1921-31 was smaller than in any inter-censal period since 1871.

The Report of the Committee on Empire Migration which has recently been published (Cmd. 4075) examines the trend of population in this country and in the Dominions, comments on the depressed state of agriculture overseas, and arrives at the conclusion that there is an economic disharmony between Great Britain and the Dominions in the matter of migration. In other words, whilst Great Britain could at present spare considerable numbers of her people for settlement overseas, the Dominions are not now in a position to absorb them. When the Dominions are in a position to absorb new settlers, Great Britain may not be able to spare them.

The decline in the inter-censal increases in Great Britain in the last two decennia (viz. from 3,832,000 in 1901-11 to 1,937,000 and 2,021,000 respectively in 1911-21 and 1921-31) will be reflected in the numbers of workers available in the immediate future. A comparison of the estimated gross average annual increase in the population of Great Britain of ages 15-65 for the quinquennia 1931-36 and 1936-41 based on the results of the 1921 Census of Population shows a striking decrease in the numbers for whom employment is to be found. The estimated numbers as shown in Appendix XXI to the Report of the Committee on National Debt and Taxation (p. 161) are :

		Persons.	Males.	Females.
Between 1926 and 1931	... ..	260,000	134,000	126,000
„ 1931 and 1936	... ..	133,000	74,000	59,000
„ 1936 and 1941	... ..	98,000	61,000	37,000

These estimates, however, may be revised to some extent when the full results of the 1931 Census are available.

Assuming that the statesmen and economists will in due time find a way out of the present economic depression and that there is a return to world prosperity, it may be expected that Empire settle-

ment and the movement to the United States will again be resumed. This renewal of emigration may be hastened, at least so far as Empire settlement is concerned, by action to minimize the effect of social legislation in this country and by assistance to emigrants by the Home and Dominion Governments. The present would appear to be a suitable time to consider both these matters, and to review the whole of the schemes which have been adopted by the Oversea Settlement Committee with a view to determining what kinds of scheme have the best chance of success, so that new schemes, possibly on a broader scale than in the past, may be put into operation as soon as the Dominions find themselves once more in a position to absorb settlers in substantial numbers. Although, in the future, emigration may be on a considerably smaller scale than in pre-war days, it may still, within the next one or two decades, be on a scale commensurate with the ability of this country to release population of the ages which the Dominions require, regard being had to the diminishing numbers of new entrants into the labour market.

APPENDIX I.

Passenger Movement between the British Isles and Places outside Europe.

All Nationalities—Outward Movement (1815–1930).
(Numbers in thousands.)

Period.	Annual Averages.				
	United States.	British North America.	Australia and New Zealand.	All Other Places.	Total.
1815–1820... ..	8	12	*	†	20
1821–1830... ..	10	14	1	†	25
1831–1840... ..	31	32	7	†	70
1841–1850... ..	109	43	13	3	168
1851–1860... ..	150	23	51	5	229
1861–1870... ..	142	20	28	7	197
1871–1880... ..	153	23	32	15	223
1881–1890... ..	255	40	38	23	356
1891–1900... ..	181	33	13	39	266
1901–1910... ..	271	114	24	63	472
1911–1920... ..	135	107	40	52	334
1921–1930... ..	158	119	51	77	405

British Nationality—Outward Movement (1853–1930).

1853–1860... ..	101	15	46	2	164
1861–1870... ..	113	13	27	4	157
1871–1880... ..	109	18	30	11	168
1881–1890... ..	172	30	37	17	256
1891–1900... ..	114	19	13	28	174
1901–1910... ..	126	84	23	51	284
1911–1920... ..	66	93	40	45	244
1921–1930... ..	76	90	50	70	286

British Nationality—Inward Movement (1876–1930).

1876–1880... ..	36	5	5	9	55
1881–1890... ..	54	8	9	12	83
1891–1900... ..	63	10	9	20	102
1901–1910... ..	62	25	10	39	136
1911–1920... ..	47	41	12	43	143
1921–1930... ..	41	48	20	65	174

* Not recorded.

† Less than 500.

APPENDIX II.

*Net Migration from the British Isles to Places outside Europe
(1876-1930).**British Nationality—Excess of Outward over Inward Passengers.*

(Numbers in thousands.)

Period.	Annual Averages.				
	United States.	British North America.	Australia and New Zealand.	All Other Places.	Total.
1876-1880... ..	47	8	28	4	87
1881-1885... ..	124	24	36	3	187
1886-1890... ..	110	20	22	7	159
1891-1895... ..	66	11	4	8	89
1896-1900... ..	38	7	4	7	56
1901-1905... ..	58	36	5	18	117
1906-1910... ..	70	84	20	5	179
1911-1913... ..	49	132	67	9	257
1921-1925... ..	38	45	37	4	124
1926-1930... ..	31	39	24	5	99

APPENDIX III.

*Outward Movement from the British Isles to Places outside Europe
(1876-1913).**Numbers of English and Welsh, Scottish and Irish Passengers.**

(Numbers in thousands.)

Period.	Annual Averages.						
	United States.	British North America.	Australia and New Zealand.	Other Countries.	English and Welsh.	Scottish.	Irish.
1876-1880	83	13	33	13	85	14	43
1881-1885	168	32	43	15	152	26	80
1886-1890	174	28	32	19	158	28	67
1891-1895	137	21	14	24	124	20	52
1896-1900	92	17	12	32	96	17	40
1901-1905	121	51	14	48	154	33	47
1906-1910	131	118	32	46	218	59	50
1911-1913	116	178	82	53	306	77	46

* Prior to 1908 particulars of British Colonials were not separately recorded in the Returns. Subsequent to April 1, 1912, particulars of the nationality of passengers were not recorded in the lists; from that date passengers travelling from or to the four divisions of the United Kingdom (i.e. England, Wales, Scotland and Ireland, and from April 1, 1923, Northern Ireland) were recorded by country of last permanent residence—permanent residence for this purpose being regarded as residence for twelve months or more. Particulars of the numbers of emigrants from, and immigrants into, each division of the United Kingdom in the ten years 1921-30 are shown in Appendix IV.

APPENDIX IV.

British Migrants to and from non-European Countries (1921–30).

(Numbers in thousands.)

Year.	Emigrants.				Immigrants.			
	From England and Wales.	From Scot- land.	From Ireland (Northern and Southern).	From British Isles.	To England and Wales.	To Scot- land.	To Ireland (Northern and Southern).	To British Isles.
<i>British North America.</i>								
1921 ...	49	16	3	68	16	1	1	21
1922 ...	31	12	3	46	13	2	1	16
1923 ...	53	29	7	89	9	2	1	12
1924 ...	39	19	10	68	11	1	1	16
1925 ...	21	11	5	40	10	3	1	14
1926 ...	29	15	8	52	8	2	1	11
1927 ...	31	16	8	55	9	3	1	13
1928 ...	33	15	8	56	11	1	1	16
1929 ...	38	20	9	67	9	3	1	13
1930 ...	19	9	4	32	11	4	1	16
<i>Australia.</i>								
1921 ...	22	5	1	28	8	1	*	9
1922 ...	31	7	1	39	7	1	*	8
1923 ...	33	6	1	40	7	1	*	8
1924 ...	31	7	2	40	7	1	*	8
1925 ...	27	7	2	36	7	1	*	8
1926 ...	32	11	3	46	7	1	*	8
1927 ...	29	10	3	42	7	1	*	8
1928 ...	22	6	2	30	7	1	*	8
1929 ...	11	4	1	19	8	1	*	10
1930 ...	7	1	1	9	11	1	1	13
<i>New Zealand.</i>								
1921 ...	8	2	1	11	1	*	*	1
1922 ...	8	3	1	12	2	*	*	2
1923 ...	6	3	*	9	2	*	*	2
1924 ...	7	3	1	11	2	*	*	2
1925 ...	8	3	1	12	2	*	*	2
1926 ...	10	5	2	17	2	*	*	2
1927 ...	5	2	1	8	2	*	*	3
1928 ...	4	1	*	5	3	*	*	2
1929 ...	4	1	*	5	3	*	*	3
1930 ...	3	1	*	4	3	*	*	3
<i>British Empire.</i>								
1921 ...	102	28	7	137	13	8	2	53
1922 ...	87	25	6	118	11	7	2	50
1923 ...	107	41	10	158	17	6	2	45
1924 ...	91	32	13	139	18	8	2	48
1925 ...	75	21	10	109	15	6	2	43
1926 ...	88	31	14	136	17	5	2	40
1927 ...	83	31	12	126	15	6	2	43
1928 ...	75	26	11	112	18	7	2	47
1929 ...	71	28	11	110	16	7	2	45
1930 ...	42	13	6	61	41	8	3	52
<i>United States.</i>								
1921 ...	21	13	19	56	9	2	3	14
1922 ...	21	14	15	50	7	2	4	13
1923 ...	33	46	24	103	4	2	2	8
1924 ...	9	6	14	29	6	4	2	12
1925 ...	14	13	29	56	5	2	2	9
1926 ...	12	14	29	55	4	2	1	7
1927 ...	10	12	27	49	4	2	2	8
1928 ...	8	12	24	44	4	2	2	8
1929 ...	12	15	22	49	3	2	2	7
1930 ...	10	12	19	41	4	3	2	9
<i>All Places.</i>								
1921 ...	132	41	26	199	56	11	4	71
1922 ...	113	40	21	174	51	9	5	68
1923 ...	145	89	31	268	47	8	4	59
1924 ...	108	39	27	174	50	12	1	66
1925 ...	91	38	39	171	45	10	4	59
1926 ...	105	49	43	197	42	8	3	53
1927 ...	98	44	39	181	45	9	4	58
1928 ...	88	38	25	161	47	10	4	61
1929 ...	88	43	33	164	45	9	4	58
1930 ...	57	26	25	108	52	12	5	69

* Under 500.

APPENDIX V.

MERCHANT SHIPPING ACT, 1906, and ALIENS RESTRICTION ACTS, 1914 and 1919.

OUT-GOING PASSENGERS.

RETURNS OF PASSENGERS LEAVING THE UNITED KINGDOM IN SHIPS BOUND FOR PLACES OUT OF EUROPE,
AND NOT WITHIN THE MEDITERRANEAN SEA.

NOTE.—*All Passengers carried by such ships are to be included, whether proceeding to European or non-European Ports. 1st Class, 2nd Class, and 3rd Class Passengers are to be entered in separate groups. Children born of alien parents in the United Kingdom should be entered in the alien portion of the Return, and the fact that they were so born should be stated in the nationality column.*

Ship's Name.	Official Number.	Steamship Line.	Master's Name.	Registered Tonnage.	Aggregate Number of superficial feet in the several compartments set apart for Passengers, other than Cabin Passengers.	Total Number of Statute Adults, exclusive of Master, Crew, and Cabin Passengers, which the ship can legally carry.	Where Bound.

I hereby Certify that the Provisions actually laden on board this Ship are sufficient, according to the requirements of the Merchant Shipping Acts, for.....Statute Adults for a voyage of.....days.

Date of Departure.....192... (Signature).....Master. Date.....192...

SUMMARY OF BRITISH AND ALIEN PASSENGERS

NATIONALITIES.	NUMBER OF PERSONS.							
	Adults of 12 years of age and upwards.				Children between 1 and 12 years.		Infants.	
	Accompanied by husband or wife.		Not accompanied by husband or wife.		Males.	Females.	Males.	Females.
	Males.	Females.	Males.	Females.				
British Subjects	...	...	...	...
Aliens { Transmigrants	...	...	...	...
Non-transmigrants	...	...	...	...
Total	...	...	...	...
					Souls.		Equal to Statute Adults.	
	Total Number of Adults				...	...
	Total Number of Children between 1 and 12 years				...	...
	Total Number of Infants				...	...
	GRAND TOTAL				...	...

We hereby Certify that the above is a correct List of the Names and Descriptions of all the Passengers who embarked at the Port of.....

Countersigned.....*Emigration Officer.* Signed.....*Master.*

Countersigned.....*Officer of Customs and Excise at*.....

Date.....192...

DISCUSSION ON THE PAPER by MR. LEAK AND MR. PRIDAY.

DR. SNOW: I have special pleasure in rising to propose the vote of thanks to Mr. Leak and Mr. Priday for their particularly interesting and readable paper. I think it will be a source of considerable satisfaction to the Society that the official statistician of the Board of Trade, so soon after his appointment, is reading a paper before the Society, and it augurs well for the future to see that the traditions associated with the names of Flux and Macrosty are likely to be continued by their successors, Leak and Priday.

The statistics of migration are frequently very difficult to follow, and it is an advantage, accordingly, that the people who are responsible for the routine handling of these statistics should come forward and interpret them to us. In this connection some of us will remember the words of Professor Greenwood in opening a discussion at a meeting last year on official statistics: "When all has been done that can be done it will remain true that much knowledge of the subject-matter as well as preliminary training in purely statistical methods must be possessed by any person who wishes to make profitable use of official data." Professor Greenwood took the view that the people who are responsible for the accuracy of the statistics are those best capable of interpreting them, and I think that most of us in this room will agree with his dictum.

The opening sentence of the paper, mentioning that no paper on migration has been read before the Society during this century, is not strictly accurate. A paper on an aspect of migration was read in the early part of 1915. It dealt, however, with a very restricted side of migration and was entitled "The Magnitude of the Population of England and Wales available for Emigration." It is of some interest to recall the circumstances of that paper. In 1912 a Royal Commission was appointed under the title of the "Dominions Royal Commission." The Chairman of the Commission was Sir Edgar Vincent, who later became Lord D'Abernon and was recently President of this Society, while another member of this Commission, Sir Alfred Bateman, was also a past President of the Society. Just before the war a very great deal of public attention was being given to the subject of migration. Emigration from this country in 1911 reached the highest point ever touched and many people began to fear that we were losing the best of our population and should suffer for it in due course. Great differences of opinion were shown on the subject. On the one hand, Mr. Harold Cox expressed the view before the Commission that this country should aim at emigrating at least 500,000 people a year as a minimum. Mr. John Burns, who was then the Cabinet Minister most closely concerned with the subject, was of opinion that the maximum we could afford to emigrate was 60 per cent. of our annual natural increase. The Commission decided to have some statistical memoranda prepared, and the paper referred to was one of them. In one of the memoranda an attempt was made to

ascertain the relationship between migration movements and other economic factors, and in view of the interesting paragraph at the end of the present paper it may be appropriate to refer to that investigation. It was found that in the case of migration to Canada and the United States there appeared to be quite a high correlation between the extent of the emigration one year and the exports to those countries in that year, while in the case of migration to Australia the highest correlation appeared to be between the exports of one year and the migration in the next year. The general conclusion reached was, "There is little evidence that migration directly causes increase in external trade. The relationship between them appears to be one of association merely. The waves and depressions of trade and migration occur together and the enquiry gives no support to the opinion that activity in migration causes activity in trade. . . . Left to itself migration appears to be a phase of a world-wide economic phenomenon—an indication of prosperous conditions. The periodic booms in trade throughout the world require some redistribution of labour, and this has been effected by migration. . . . On the whole question of the relationship between migration and general prosperity the most simple hypothesis to account for the fact that, under the unconstrained conditions existing during the greater part of the period from 1878 to 1911, migration from the United Kingdom to the Dominions was associated with times of prosperity is that migration is an important aid to commercial and industrial welfare by effecting the translation of labour to its most productive spheres. It is not justifiable to assume from this, however, that the *artificial* transportation of a considerable population to the Dominions in a time of industrial stagnation is necessarily going to do much to accelerate the time of prosperity."

On the question of the emigration of women some rather unexpected results came from the statistical analysis. A number of associations which advocated female emigration pointed to the very high surplus of women in this country, at that time amounting to about 1,200,000. When this figure was analysed it was found that the surplus of unmarried females was only 300,000, and when further analysis was made of the population aged 15 to 35 the surplus of unmarried women over unmarried men was almost negligible.

There are three points in the paper that I should like particularly to refer to. The first is that of the future of migration. The Overseas Settlement Department appear to take a very optimistic view and consider that migration will flow in considerable volume again. The writers of the paper appear to be rather more cautious. My own opinion is that emigration from this country for some considerable time ahead, say, at least a decade, will be on a relatively small scale. I think that a study of the history of migration over the past century supports this view. There was a long period when the power making for emigration was a force *repelling* people from this country. This was certainly so over a considerable part of the first half of last century, when conditions

in this country were so bad that people with little knowledge of conditions on the other side went away in the hope of improving their standard of life. Over the later part of the second half of the century, however, the power making for migration was an *attractive* force from the other side. The development of railways, etc. had opened up new fields for agriculture; labour was required, and it was attracted to these spots. I am inclined to think that now we have reached a stage when there is neither much attraction to the other side nor much repelling force from this side. So far as the repelling force is concerned, Mr. Leak has referred to the effect of social insurance in this country, and there can be little doubt, I think, that the prospects of having a pension at sixty-five in this country, if they remain here, must create a frame of mind tending to keep people here rather than to make them think about going to other countries. The attractive force to the other side would also appear to have ceased. It has been recently stated that "A farmer using modern agricultural machines can now accomplish in one hour what it required 3,000 hours for him to do a century ago." The development of machinery in agriculture appears to have reached such a stage that we can expect very little demand in agricultural countries for emigrants for some considerable time to come. For these two reasons I am inclined, personally, to take the opposite view from that of the Overseas Settlement Department, and consider that emigration from this country will be at a low ebb for some years to come.

The second point I wish to refer to is the effect of the cessation of emigration on employment in this country. Some very interesting figures are given in Table X. These show that in the decade following the war we emigrated about 110,000 people a year. The figures for the last three years, however, show no less than 390,000 below that average. In other words, there are about 400,000 people in this country now who would not have been here if the average rate of migration of 1921 to 1929 had been maintained in the last three years. According to the figures in the table, about half of these would be men, so that from this point of view we can say that the cessation of emigration is responsible for 200,000 of the unemployed. The gravity of these figures will be appreciated if we look ahead. Supposing the experience of the past three years continues for the next five years, we shall have a population of about 1,000,000 more in 1937 than we should have had if the average rate of migration had continued, and this, of course, is a very important factor in considering employment in this country.

The third point in the paper to which I should like to refer is that of the effect of this cessation of emigration on the age distribution of the population. A few years ago, some of us in this room, for various purposes, made distant forecasts of the population in this country up to 1941. We expected the total population throughout the decade of the 'thirties to increase but slowly, but the important point in the calculations was that there was considerable increase to be expected at old ages and an actual decline

at young ages. At the present time, if migration had continued at the level of the decade 1921 to 1929, the population in the age group 15 to 35 would actually have been diminishing. It is just this particular age group which emigration used to draw from most heavily, and accordingly the cessation of emigration means that the population in this age group is not declining to the extent that was expected. From this point of view, accordingly, the cessation of emigration has some advantage. It is tending to keep up the population in young and middle life, and we are, as a consequence, maintaining a more stable age distribution.

I have mentioned three points in the paper which I consider especially important, namely, the future of migration, the effect on employment, and the effect on age distribution in this country, but there are many other points of interest and I have no doubt that those taking part in the discussion will refer to them. I think the paper is a most valuable one and I have very great pleasure in formally proposing the vote of thanks to Mr. Leak and Mr. Friday.

DR. ISSERLIS: My first duty is to express my own pleasure and gratification at the excellence of the paper that has been put before the Society by two Fellows who are closely associated with a great Department of State. For this part of what I have to say it will be sufficient for me to associate myself with the previous speaker, who spoke not only with remarkable ability, but with amazing modesty; he carefully concealed the fact that the able statistician who contributed the statistical discussions and memoranda to the Dominions Commission—some of which have become classical—was speaking to you.

Compliments on the paper are particularly deserved when one considers the extraordinary difficulty of the material. It requires very able guidance to enable readers of official statistics to find their way between passengers out of this country and emigrants out of this country, and of course the same applies to inward travellers. I do not suppose the authors of the paper will claim that they have completely overcome the difficulty, because so much of it depends not on responsible people filling up forms which they are required to do by statute, but on the personal statements of individual passengers or possible emigrants, and these are, of course, not always reliable; in fact, the outward-bound passenger is not always aware himself whether he will take up residence in the foreign country outside Europe for a year or for longer.

It is possible that some of those agricultural workers who returned from Canada had fully intended to stay there for good if they could get permanent work.

Speaking of the figures as a whole, particularly the aggregates, I should like to ask Mr. Leak if he has ever considered the possibility of using the aggregate figures in a rather different connection, that is, in providing a measure of exposure to risk in the case of passengers travelling by sea. In the last year or so, this number was rather over three million people, but some of the journeys

were very short ones. A Channel crossing may be very uncomfortable but need not last more than a couple of hours. I have often tried, but confess I have failed, to compare the risk of death to a passenger by sea with the risk of death to a passenger by train or by motor-car; this latter is complicated by the extraordinary liability of the motor-car to kill other than passengers.

One passage in the paper that interested me greatly, and has already been referred to by Dr. Snow, is the correlation of the volume of migration with periods of prosperity in trade. As stated in the paper, Sir Robert Giffen was definitely of that opinion as long ago as 1886. I myself was responsible for making a similar statement before the Oversea Settlement Committee in 1926, but the authors of the paper have pointed out that migration may increase either because trade is good here or in the United States, or because there is a famine in Ireland, and Dr. Snow, I think, sums up the position by saying that the best we can say is that there is association between prosperity either in the same or previous year and the volume of migration, but it is very difficult to say that one causes the other. The paper not only gives an analysis of the past statistics,—it goes a little beyond statistics and expresses opinions as to desirable things to be done by the Government of this country or others in the future. The suggestions for commuting social insurance payments of various kinds in the case of an emigrant are of great interest. This question of the disinclination of the emigrant to leave because of the value to him of the various forms of social insurance is important, but there is another side of the picture, which perhaps the powers that be in the Dominions have not considered—that is, that the emigrant whom they wish to have, the well-brought-up young man of between fifteen and thirty-five, has cost this country a good deal to bring up to that age, and the Dominions want to have that young man very often just at the time when he begins to have a net value to the country which has produced him. I put the figure forward as a tentative one, and it refers to the costs of five or six years ago, when I estimated that the community, including the child's parents, must have spent five or six hundred pounds on the boy before he reaches the age of fifteen, especially if he is the kind of boy the Dominions want to have. When the time of prosperity comes and Australia and Canada ask us to help them by furnishing them with suitable emigrants, instead of asking this country to pay towards the cost of the passage, they might be asked to pay a commutation fee for each emigrant.

I have much pleasure in seconding this vote of thanks.

MR. G. F. PLANT, Secretary of the Oversea Settlement Committee, said that in the first place he would like to associate himself with the proposer and seconder of the vote of thanks in congratulating very heartily the writers of this excellent paper. It deserved, and no doubt would receive, very careful study from all who were interested in migration. In the meanwhile, he would like to offer a few observations on one or two points which occurred to him.

The first of these concerned social insurance. Perhaps the Maclean Committee might feel more concern to-day than they did in 1926 as to the effect on migration of schemes of social insurance in this country. But at any rate, one thing seemed clear, and that was that there had been a change of attitude in the Dominions towards such provision as that which was made under the British Unemployment Insurance Acts. The world-wide economic depression had shown the Dominion people that a man might be willing to work and yet be unable to find a job. The old hard saying, "If a man will not work neither shall he eat," which he heard so often in Canada in 1928, would probably not be heard so frequently in future, and sheer force of circumstances might compel the Dominions to pass similar legislation to that of Great Britain in this and in other directions. One would expect this to have the effect of stimulating the migration movement.

The second point he would like to mention was that concerning returning migrants. It was not always borne in mind that returning migrants were different in type from those who were proceeding overseas. Attention was called to this fact by the Dominions Royal Commission in their Final Report, where they said that the returning inward flow differed from the outward flow in the essential characteristics of age and wealth. The report went on to say, "Those who migrated were young and were in pursuit of fortune; those who returned were of mature years and in many cases had achieved success and acquired wealth."

The paper made both these points clear. It showed that in 1921 to 1930, when the percentage of immigrants to emigrants was so high, 60 per cent. of the adult immigrants were over thirty years of age as compared with 45 per cent. of the emigrants. Moreover, the proportion of persons travelling first and second class was higher in the case of the inward movement, and this proportion had actually increased since the war.

The third point was in connection with family migration. The Oversea Settlement Committee had always regarded family migration as the ideal form of migration. It was noticeable from the figures given in the paper that both before the war and after it, 35 per cent. of those who emigrated from this country went as families. The proportion was still higher in the case of assisted migrants, being rather more than 50 per cent.

Then there was the question of aliens, and it would be seen that in 1920 to 1930 there was an excess of outward alien passengers to the extent of 4,000. This dealt effectively with the criticism which had been made that whilst the Government had been encouraging the migration of British people to other parts of the Empire, it had not been regulating the alien movement into this country.

As regards the standards of selection of assisted migrants, the Dominions, if they were assisting migration, ought to have the right to insist on a high standard mentally, morally, and physically, in the case of those to whom assistance was being given, and it would no doubt occur to everyone that if those who had been

rejected in the past had been allowed to go to the Dominions, their position would have been extremely difficult in these days of depression which were trying the endurance even of the best of our people.

Finally, he (the speaker) cordially agreed with the conclusion arrived at by the writers of the paper as to the undesirability of associating unemployment and emigration.

So far as the future was concerned, the Oversea Settlement Department was taking advantage of the present lull in migration to consider the best policy to be adopted in connection with the problems of Empire settlement when trade revived and migration could once more be resumed. He would like to add that, so far as he could judge from past experience, oversea settlement must always involve some degree of difficulty and hardship. To transplant an individual was very like transplanting a tree. The uprooting process was a great wrench; to get a fresh start in strange soil could not be easy. In fact, it would seem that if Empire migration was to be carried out in the best possible way, there must be something of the missionary spirit about it. For this reason he could not help feeling that the Churches, if properly organized, ought to be able to play a very big part in assisting and stimulating this Empire movement in the future.

Mr. Plant finally expressed his gratitude to the Society for the opportunity afforded to him of taking part in the discussion.

LT.-COL. C. WALEY COHEN thought the authors of the paper were to be congratulated upon dealing scientifically with this very important question, because when one came to realize it the country was faced to-day with a standstill position in regard to migration. When one came to analyse the cause of that standstill, it would be found that the cause was the same as that of the standstill which was affecting trade and banking. The real cause was the extraordinarily low level of wholesale prices and lack of increased wealth in the Dominions.

He noticed that the reader of the paper quoted the statement of Sir Robert Giffen, who always replied, "But you have omitted the qualification." It was quite true that migration had always been greater in times of prosperity, but it was also true that migration had been stimulated whenever there was a very marked difference between conditions in one part of the world and another, such as Ireland and Canada, in the 'eighties, and it was necessary to add that qualification because some of the biggest migrations had taken place from the United Kingdom, when, for instance, there was famine in Ireland or congestion of population in Great Britain.

When this question was under consideration before the war, by Lord Tennyson's Committee, at the request of Mr. Wilson Fox, Lt.-Col. Waley Cohen and Canadian economists went into the question and came to the conclusion that Canada could only absorb an extra family if it had an increase of £100-£150 of extra capital. This was an aspect of the question that might quite well

be examined by the authors of the paper in connection with this interesting matter of statistics.

One of the reasons of the standstill was that owing to the fall in prices, the capital of Canada and of the Dominions had depreciated so much that instead of having more capital to employ more men, they had not enough capital to employ their own people in their own country. That contrast suggested another thing, that if one wanted to stimulate the migration of people from this country, one of the things to be done was to direct the investment of capital to the British Dominions as far as possible. There was no shadow of doubt that the capacity of other Dominions to absorb fresh emigrants would depend upon increased wealth and capital.

Sir Josiah Stamp estimated some time ago that it required £1,000 to £1,600 to employ one family in the United Kingdom. Evidently his investigations were more or less on the same lines as those which Lt.-Col. Waley Cohen had himself made before the war. There was one error in the paper—namely, the suggestion that the scheme by which Canadian doctors were sent over to England to examine emigrants for Canada was in any way in deference to the Report of Sir Donald Maclean's Committee. It was a most unfortunate experiment and created a great deal of irritation. It was not in any way initiated in deference to the Report of the Committee.

Another point worthy of mention was that it was very difficult to estimate how far social insurance had affected migration. In making investigations amongst the unemployed, the opinion was unanimously expressed that even to-day social insurance was not the main factor in the fall in migration. In the evidence before the Select Committee of 1885-6 and before Lord Tennyson's Committee, the general opinion was expressed that the real thing that made people emigrate, apart from extreme social pressure, was the go-fever. The desire to visit new places was still as strong as before among young people.

It was almost inconceivable, but the fact, that in Canada a British immigrant woman who married a Canadian might find herself sent home again as an undesirable immigrant six years later. Many of the people who had proved to be very desirable workers in this country had been excluded both from Australia and Canada. Lt.-Col. Waley Cohen said he had never known any representative of any Dominion who ventured to defend the present restrictions on migration which existed, particularly with regard to Canada and, to a lesser extent, to Australia and New Zealand. It was necessary to re-examine the whole question in consultation with the Dominions, and in this re-examination one of the things that would have to be carefully looked into was how, in normal times, if more migration were wanted from Great Britain, the increased wealth of the Dominions could be fostered so as to enable the emigrants to those Dominions to be absorbed.

COMMISSIONER LAMB (Salvation Army) said he had come to the meeting to learn, because he felt there was nothing more important

than the impulse referred to in the very able paper under discussion. He had not come prepared to speak, but to listen, and he had listened with pleasure and certainly with profit. It was new to him to think that, with three million people unemployed in this country with no apparent prospect of employment, that in itself was not going to be an expelling force; he did not agree that this country could go on carrying three million unemployed people for ever.

Reference had been made to women. He had expected at this meeting to get up-to-date statistics, but the estimate given of excess women was more than ten years old; the figures of to-day showed the excess to be over two millions. In Queensland some years ago the number of men in excess of women in the population was shown to be about 37,000; it is now over 40,000. No one could think that an Empire could be built up with women in excess in one part and men in excess in another. Surely that was a great mistake.

Then there was the Report on Empire Migration prepared by the Empire Economic Committee with all the resources of the British Government at its disposal. The depressed state of agriculture overseas was commented upon, and from that it was deduced that there was economic disharmony and no opportunity for emigration from this country. The Committee appeared to be unaware that agriculture in England, Scotland and Ireland was depressed. If the depression was worse overseas than it was in this country it must be pretty bad, but the conclusions were drawn from the depressed condition of agriculture overseas. For the first time in the history of statistics there were thousands of unemployed agricultural labourers in East Anglia.

Mr. Plant had endorsed what Mr. Leak said "that harm is done to the emigration policy of this country by the direct association of this question with a solution of our unemployment problem appears probable." He (the speaker) would rather stand for the truth, but what was the truth? Mr. Plant must have overlooked the two lines immediately following, because there was the fact: "So far from dumping our undesirables on the Dominions it appears more likely that they have withdrawn some of the best labour from this country." In the Industrial Transference Board's Report issued four or five years ago it was stated that there were some 200,000 workers of first-class capacity unemployed in this country who were never likely to be absorbed in their particular trade. If anyone thought the question of British Empire migration could be separated from the problem of unemployment in this country they were mistaken, and Commissioner Lamb found it impossible to agree with them. He agreed with the finding of the Industrial Transference Board, that emigration on a large scale *was* a way out.

The world movement westwards was causing great disturbance in world politics. If that movement had been southward, it might have stirred up the British Empire to do something. It was said that the movement to the United States would again be resumed, but there seemed to be no likelihood of this being so.

It had been estimated that the capital value of a successful immigrant family was about two thousand pounds. In Germany there were many families ready and anxious to emigrate. Would anyone put up the proposition to the United States to take a million families during the next ten years from Germany on this basis by way of solving the reparations problem? What was wrong with such a suggestion?

Referring to the last paragraph of the paper, "Assuming that the statesmen and economists will in due time find a way out of the present economic depression, and that there is a return to world prosperity . . ." Commissioner Lamb suggested that that sentence might read: "Assuming that under pressure of the humanitarians, the statesmen and economists, with or without bankers and industrialists, will presently find a way out of the present economic depression, then there will be an early return to world prosperity."

MR. STANLEY JEVONS said that as an economist he had always been interested in migration, but he had been discouraged from attempting to study migration to and from Great Britain on account of the great difficulty in assessing the value of the statistics. Economists would be grateful to the readers of the paper for having provided a guide towards understanding the statistics of migration. He was not yet entirely satisfied that all the chances of error were eliminated by the method in force. He would like to know the opinion of the authors on the question of what amount of leakage there was into this country from the Continent of persons who came across in fishing boats or as stowaways or deserters from the crews of ships. It appeared that since the introduction of the Aliens Restriction Act it was possible that migration statistics had become a good deal less accurate than they used to be as representing the real movements of migration.

As to the causes of migration, most economists would agree that the migration of European peoples in modern times had been due mainly to the attraction of better conditions abroad of which they learned. He had made some study of migration within the Indian Empire, and it was quite clear that whilst attraction was the cause in a good many cases, distress also was a cause, and sometimes both factors operated simultaneously.

As regarded the economic effects of the change which had come over the emigration situation of this country, there was one interesting point, and that was the effect upon freight rates of steamship companies. It must be remembered that in pre-war days the emigrant traffic was enormously important to many steamship companies, both the Atlantic lines and those to Australia, and that a good deal of their revenue was derived from that source. Since the war they had had to be content with very little in that way, and since the steamship owner had to make his profits out of the round trip, and the export trade had not grown to take the place of emigrant revenue, there seemed to be a very good reason for the fact that import freight rates affecting raw

materials were much higher than they used to be, and than British industries could stand. That was having an adverse effect upon some of our big industries which drew their raw materials from America and the colonies.

MR. MACROSTY said that he felt he was almost in a quasi-parental relation to the paper, because three years ago he first suggested to his colleagues in the Statistical Department of the Board of Trade that it was about time they had a paper on migration. That Department was always very busy, but in the fullness of time this paper had now been presented, and everyone would agree with him in saying it was a paper well worth waiting for.

Dr. Snow had spoken of Mr. Leak and Mr. Priday carrying on a practice which Mr. Flux and he had followed when they were in the Board of Trade, but, in fact, the association between the Board of Trade and the Statistical Society was so close that it had always been the habit of the officials of the Statistical Department to compile reports in their leisure moments for the Society, and this dated back to the very beginning of the London Statistical Society. He hoped that this tradition, which had been carried on for nearly a hundred years, would continue as long as the Statistical Society and the Board of Trade continued to exist. At all events, this paper was a very good omen for the future. When the new Head of the Statistical Department of the Board of Trade came with a piece of work like this paper after such a short time in office, one was led to hope that the Society would have many more such papers from him and from his colleagues in the Department.

There were two points in the paper to which Mr. Macrosty wished to refer. First, as to the decline of migration in the last decade and its probable effect upon employment in this country. It was quite possible to over-estimate the effect which that decline had had by throwing more people on the labour market in this country, because it had been coincident with a remarkable decline, running back for a long period, in the birth-rate. The one must be set off against the other. The second was in connection with the impelling cause of migration. Previous speakers had inferred that there were two forces acting independently, whereas they acted together. At one time the attractive force from one side might be the greater and at other times the expulsive force from the other side might be the greater, but no one would migrate unless he hoped to better himself, however bad his condition might be in his homeland. In that connection, when people talked about the movement from Scotland in the end of the eighteenth century, they should get their facts correct, because it was not over-population in the strict sense of the term which caused the movement. The expelling force was sheep. It was the development of sheep farms which cleared out the crofters from the better lands, and that was the immediate cause of the overseas migration. Subsequently the sheep were themselves expelled by the deer.

Mr. Macrosty said he had much pleasure in putting to the meeting the vote of thanks, already proposed and seconded.

(The vote of thanks was carried unanimously.)

MR. H. LEAK in reply, said : I appreciate very much the manner in which the paper Mr. Priday and I prepared has been received by the Society, and I should like to express my gratitude for the very kind remarks which have been made by the various speakers. I trust Dr. Snow will pardon my not referring in the opening paragraph to his paper on the magnitude of the population of this country available for emigration. I read the paper with considerable interest, but though it dealt with migration, it did not deal with migration statistics as such.

In regard to the few criticisms on points of detail, I will make an amendment to meet the point raised by Colonel Waley Cohen regarding the examination of emigrants by Canadian doctors in this country. I do not think there is anything in the suggestion made by Professor Jevons, and I hope he will be reasonably satisfied with the data included in the paper as having a fair degree of accuracy having regard to the imperfections of the systems under which they were compiled.

I am extremely glad that the paper has led to such a useful discussion; that was one of the objects we had in mind in preparing it. The other point we had in mind was to bring together the post-war statistics and to endeavour to indicate what they meant.

I trust the observations made in the paper and by the various speakers will receive the careful consideration of those who are responsible for the formation of Government policy in this important matter of migration. I should like to take this opportunity of again thanking the Society.

As a result of the ballot taken during the meeting the following candidates were unanimously elected Fellows of the Society :

R. W. Meekins,
Jamini Bhusan Mukerjee.

Jerzy Neyman.
Reginald Edward Watts.

SOME ASPECTS OF THE MORTALITY FROM WHOOPING-COUGH.

By A. BRADFORD HILL, Ph.D., D.Sc. (of the Statistical Staff of the Medical Research Council).

[Read before the Royal Statistical Society, Feb. 21st, 1933, PROFESSOR MAJOR GREENWOOD, F.R.S., Vice-President, in the Chair.]

Historical Summary.

"ON the whole, from all the enquiry I have been able to make, I am fully of opinion, with the learned Astruc and others, that the Chin-cough, as it now exists, has not been described by any of the Greek, Roman, or Arabian Authors." This is the conclusion reached by Dr. Robert Watt in his *Treatise on the History, Nature and Treatment of Chincough*, published in 1813. It seems curious, as Creighton observes, that "a malady so distinctly marked as whooping-cough is should figure so little in the records of disease from former times." * Yet the first known account of an epidemic falls as late as the year 1578, when Guillaume de Baillou of Paris (1538-1616) included a "prevalent convulsive cough as part of the epidemic constitution of that year." † An earlier account is referred to in the 1861-70 Decennial Supplement of the Registrar-General for England and Wales (p. xxxix), it being there stated that "whooping-cough first appeared in France in 1414; and Mezerai says it cost the life of every person it attacked." But according to Hirsch this, and other earlier accounts, cannot be substantiated as definitely relating to whooping-cough; they rest upon "arbitrary interpretations of the text or upon errors of diagnosis, such as the confounding of whooping-cough with influenza, an error towards which the application in France of the popular name 'coqueluche' at one time to that disease and subsequently to whooping-cough has contributed a good deal." ‡ In the seventeenth century only occasional references are to be found to the disease, and not until the eighteenth, according to Hirsch, do accounts of epidemics become numerous. Hirsch concludes that it is impossible to decide whether this lack of reference really denotes a relatively modern origin. From the fact that in some countries whooping-cough has appeared only at wide intervals of time, and is directly traceable to importation from without, he deduces that its

* *History of Epidemics in Britain*, Vol. II, Ch. VI, Whooping-Cough, pp. 666-77.

† *Ibid.*

‡ Hirsch's *Handbook of Geographical and Historical Pathology*, Vol. III, p. 28. Translated by Charles Creighton, 1886.

"native habitat" is certainly by no means so extensive as its present geographical distribution. Sticker * lays stress upon the fact that between Baillou's account in 1578 and Thomas Willis's in 1658 no true epidemic is recorded. On the other hand, Creighton believes that the lack of reference to the disease in the medical "compend" is sufficiently explained by Willis's remark that its management was left in the hands of old women and empirics. "About the curing of this disease, the way of healing used in other kinds of coughs doth rarely profit here; wherefore old women and Empiricks are oftener consulted than Physitians, and the rational curatory method being postponed and neglected, remedies for the most part onely Empirical are brought into use." † This seems curious, since if its incidence was of the same order then as it is to-day, whooping-cough must have been one of the important causes of infant mortality. (Yet in New York State in 1928 Godfrey reports that "after the 'whoof' begins many mothers, and practically all grandmothers consider themselves quite as competent as a physician to deal with the situation.") Willis, however, refers to it as seldom "very dangerous or mortal," though "it remains very difficult of cure; and frequently it rather ceases by change of the season than is extinguished by remedies." This author also refers to whooping-cough in his treatise on the Pathology of the Brain,‡ where he states that "this kind of convulsive cough is very frequent among children, and some years lays hold on so many, that it seems to be plainly epidemical: when it roots itself, it is very difficult to be cured by remedies; yea, often being long protracted, it is hardly otherwise to be cured, but by the state of the year being changed." Again he makes no reference to its fatality but possibly his observations were limited to older children upon whom the fatality rate does, today, fall lightly. In the Bills of Mortality, "Hooping-cough and chincough" first appears as a separate item in 1701. The deaths accredited to it are exceedingly few to begin with (in twos and threes) and rarely exceed a hundred for the first half of the century; in the latter half of the century there is a steady annual total of some hundreds. This increase, Creighton remarks, can hardly be explained except on the hypothesis of more exact classification of infantile deaths, corresponding to the decline under the heading "convulsions" in the second half of the century. Watt in his study of the registers of the Glasgow burial grounds § finds that whooping-cough is responsible for about 5 to 5½ per cent. of all deaths between 1783 and 1812 (or at ages under 5 years for 10

* Georg Sticker, *Der Keuchhusten*, 1896.

† Tho. Willis, 1674. *Pharmaceutice Rationalis*, Part II, Sect. 1, Chap. VI.

‡ Tho. Willis, *An Essay on the Pathology of the Brain and Nervous Stock; in which convulsive diseases are treated of*.

§ Robert Watt, *Treatise on Chincough*, Glasgow, 1813.

per cent. of the deaths). This ratio is higher than that of the London bills of the same period—about 2 to 3 per cent. of all deaths, and Creighton says that it was probably the maximum in Britain, “inasmuch as the Glasgow death-rate of infants was the worst from all causes.”

Utilizing a part of his data, Watt shows that 94 per cent. of the deaths from whooping-cough were of children under 5 years of age, a ratio that does not differ appreciably from that of modern times (97 per cent. in 1921–30).

The vital statistics of Sweden have long shown whooping-cough as a significant cause of death. From 1749 to 1764 there was an annual average of approximately 2,650 deaths. The general opinion of writers is that no differences of race and nationality create a pre-disposition to or an immunity from this disease. Watt, it is true, states that “in warm climates, besides being less frequent, it is also less severe, and this is probably the true cause why it was scarcely, if at all, mentioned by the Ancients,” but this suggestion cannot easily be accepted. Hirsch concludes that the information from the southern countries of Europe is so defective and covers such short periods that it is impossible to say whether the disease is less common or less severe in them than in the northern parts of the Continent. For Roumania, Turkey and Greece there is, he says, no lack of information as to the epidemic occurrence of the disease. Modern statistics show, according to recent reports by the League of Nations Health Organization, that whooping-cough is at present exceedingly widespread. It causes a greater mortality than either diphtheria, scarlet fever or measles in the Scandinavian countries, the Netherlands, Germany, Switzerland and Austria as well as in Japan. In Italy from 1926 to 1928 over thirty thousand cases were annually notified, and in 1926 there were 2,046 deaths from whooping-cough at ages under one year. This gives an infant mortality rate from this cause of 1,869 per million compared with a rate of 2,758 per million in England and Wales in 1921–30. Part of this difference may be due to different standards of notification, but, ignoring that, the incidence in Italy seems sufficiently high to deny, according to modern figures, the possibility of absence of comment in ancient writers being due to absence of cases and deaths as a result of climatic differences. The severity of whooping-cough may be less in warm climates, but it does not seem likely that it is so much less as to make it a negligible cause of illness and death and one therefore to be ignored.

Mortality in England and Wales since Registration.

Coming to recent years we find that during the last decade, 1921–30, whooping-cough was responsible, in England and Wales,

for forty-four thousand deaths, or, roughly, 1 per cent. of the total mortality of the population. Practically all these deaths (97 per cent., *vide* Table I) were concentrated on the age group under 5 years, and Table I shows that at these ages whooping-cough, in 1921-30, was the most important cause of death amongst the common infectious diseases of childhood.

TABLE I.

England and Wales. Number of Deaths recorded from certain Common Infectious Diseases of Childhood.

Decade.	Number of Deaths.				
	Measles.	Scarlet Fever.	Whooping-cough.	Diphtheria.	Total.
1901-10	105,481	36,083	94,548	60,924	297,036
1911-20	98,679	17,056	65,380	50,582	231,697
1921-30	42,405	8,849	44,293	32,704	128,251
Percentage of the deaths that were at ages under 5 in 1921-30	91	46	97	48	

Taking all the various causes of death at ages under 5 years, whooping-cough, between 1896 and 1910, remained steady at ninth upon the list in order of importance as a cause of mortality. During 1921-30, although its absolute position improved very materially, its relative position worsened and it rose to fifth place in the list of causes of mortality at ages under 5, as a result of the greater relative decline in the number of deaths due to measles, all forms of tuberculosis and the diseases of infancy recorded under convulsions and congenital debility.

This importance of whooping-cough as a cause of death early in life is, perhaps, not always sufficiently realized. Its importance remains in spite of the enormous improvement that has taken place in its mortality during the last three-quarters of a century, an improvement that is shown in Table II and Fig. (i), where the death-rates from measles and whooping-cough under 5 years of age are contrasted. In 1861-70 the male mortality from whooping-cough was 3,408 per million, and the female mortality 4,157 per million. In 1921-30 the corresponding rates were 1,147 and 1,415, only one-third of the rates sixty years previously.

The fall in mortality from measles was nearly as great, the male mortality in 1921-30 being but 40 per cent. of that recorded in 1861-70 and the female rate having fallen to 37 per cent. of the earlier level. A point of contrast is to be seen in the greater fluctuations of the measles mortality, and the concentration of the

major part of the decline in recent years, whereas the death-rate from whooping-cough has shown a more continual decline, though the larger part of it has taken place in this century. This decline

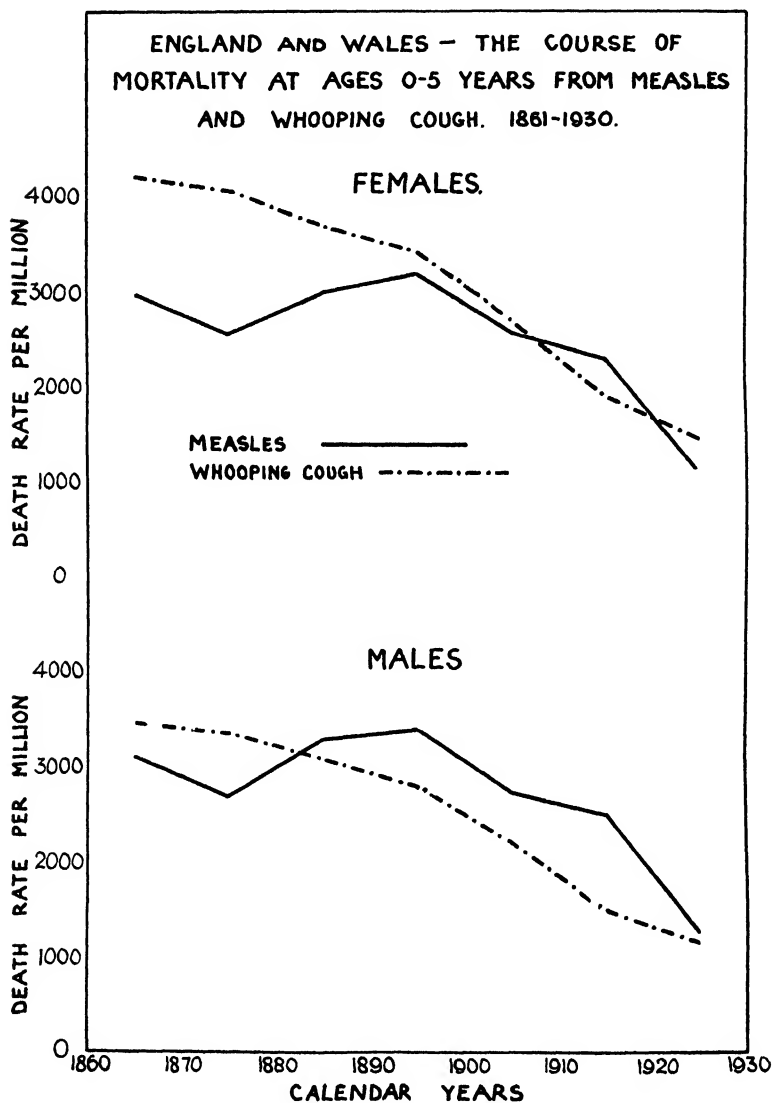


FIG. i.

in mortality is not evenly spread over the first five years of life. Table IIA shows that in infants under 1 year of age the mortality has been somewhat more than halved—the rate in 1921-30 was 40

per cent. of the rate in 1861-70. In the second year of life the mortality has fallen by two-thirds and from age 2 to age 5 it has fallen by very nearly three-quarters. Older children have gained more than infants. The decline does not differ appreciably between the sexes.

TABLE II.

England and Wales. The Death-rate per million at ages under 5 from Measles and Whooping-cough in each Decennium from 1861-70 to 1921-30.

	Measles.				Whooping-cough.			
	Death-rate per million.*	As per-centage of death-rate in 1861-70.	Death-rate per million.	As per-centage of death-rate in 1861-70.	Death-rate per million.	As per-centage of death-rate in 1861-70.	Death-rate per million.	As per-centage of death-rate in 1861-70.
MALES.		FEMALES.		MALES.		FEMALES.		
1861-70 ...	3,080	100	2,942	100	3,408	100	4,157	100
1871-80 ...	2,653	86	2,504	85	3,323	98	4,011	96
1881-90 ...	3,266	106	2,989	102	3,062	90	3,668	88
1891-1900 ...	3,368	109	3,126	106	2,786	82	3,385	81
1901-10 ...	2,695	88	2,507	85	2,170	64	2,683	65
1911-20 ...	2,493	81	2,293	78	1,496	44	1,896	46
1921-30 ...	1,219	40	1,085	37	1,147	34	1,415	34

* The death-rates up to 1901-10 are those given by the Registrar-General in the 1901-10 decennial supplement. For the final two decades they were calculated by the addition of the recorded deaths and the population exposed to risk taken as the mean of the Registrar-General's estimated population at ages under 5 for each year during 1911-20 and 1921-30.

Compared with other causes of death, Table IIA shows that whooping-cough mortality has fallen equally with these other causes at age 0-1 year, but at a slightly slower rate at ages 1-5 years. Relative to these other causes females have not made quite as much progress as males; for from other causes they show a greater decline than males, while from whooping-cough this greater decline is not apparent. The relative decline of whooping-cough compared with other causes may, of course, be an under-statement. In the Registrar-General's Decennial Supplement for 1891-1900 it is pointed out that the recorded death-rate does not completely represent the loss of life for which whooping-cough is responsible. "Many of the deaths from bronchitis and other diseases of the lungs have their origin in antecedent whooping-cough, although the fact is not always stated in the certificate, and consequently the mortality from this affection is under-stated." If, therefore, regis-

tration by cause was more accurate in 1921–30 than in 1861–70 the decline in mortality between the two dates must be under-stated.

From Table IIA it will also be observed that the mortality from whooping-cough falls mainly upon the first two years of life. For both males and females it falls continuously and rapidly with rising age. This represents a rapid decline with age in the case fatality of the disease, since according to available data of notifications (*vide* figures for Glasgow and Aberdeen referred to in Table VII) the attack rate between age 0 and age 5 falls relatively slowly, *e.g.* the attack rates in Aberdeen (1891–1900) were, at ages 0–1, 65·7 per

TABLE IIA.

England and Wales. The Decline in Mortality at individual ages from under 5 years in (a) Whooping-cough, (b) all other causes of Death, between 1861–70 and 1921–30.

Age.	Whooping-cough death-rate per 1,000.		1921-30 as per cent. of 1861-70.	Death-rate per 1,000 from all causes less Whooping-cough.*		1921-30 as per cent. of 1861-70.
	1861-70.	1921-30.*		1861-70.	1921-30.	
MALES.						
Under 1 ...	6.99	2.73	39	193	80	41
1- ...	5.36	1.80	34	68	17	25
2- ...	2.27	0.62	27	32	7.6	24
3- ...	1.14	0.30	26	21	4.7	22
4-5 ...	0.60	0.17	28	16	3.7	23
FEMALES.						
Under 1 ...	7.53	3.01	40	153	59	39
1- ...	6.78	2.32	34	63	14	22
2- ...	3.19	0.93	29	31	6.4	21
3- ...	1.70	0.46	27	21	4.1	20
4-5 ...	0.90	0.23	26	15	3.3	22

* Deaths divided by mean of R.-G.'s estimated populations at each age for each year 1921 to 1930.

1,000 for males and 73·6 per 1,000 for females; at ages 4–5 they were 49·7 per 1,000 for males and 59·4 per 1,000 for females, a decline of 24 and 19 per cent. respectively. The corresponding case fatality rates (per 100 cases) were 13·1 and 12·0 at ages 0–1 and 2·0 and 1·9 at ages 3–5, a fall of 85 and 84 per cent. The fatality rate therefore falls between these ages about four times as fast as the attack rate. Between the ages of 0–1 and 2–3, according to these same Aberdeen figures, the attack rate remains nearly constant, but the fatality rate falls by approximately three-quarters. There is not much doubt that notifications were incomplete in these towns, but it is very unlikely that they were so incomplete and so differ-

entially distributed over the age-groups as to nullify this contrast between the death-rates and the attack rates. Stocks, in a study of four London boroughs, has also found a very rapidly declining fatality rate.*

The Female/Male Ratio of Mortality.

The death-rates in Tables II and IIA reveal one of the anomalies of whooping-cough mortality that has long been recognized, viz. the consistently heavier mortality of female children at each age. Whooping-cough is the only important cause of death between ages 0 and 5 for which this peculiar incidence is to be observed. The ratios of female to male death-rates for various causes are shown in Table III.

TABLE III.

England and Wales. The Death-rates at ages under 5 of Females expressed as a percentage of the corresponding rates of Males.

	100 F./M. 1861-70.	100 F./M. 1901-10.	100 F./M. 1921-30.
All causes	87	84	80
Measles	96	93	89
Scarlet Fever	95	94	96
Whooping-cough	122	124	123
Diphtheria	103	98	96
Diarrhoeal diseases	80*	84	74
Tuberculosis (all forms)	82	84	83
Pneumonia (all forms)	84	83	81
Bronchitis	85	83	81
Violence	78	86	71

1871-80.

Taken as a whole the female mortality is 15 to 20 per cent. less than that of the males, their advantage being greater in respiratory and digestive diseases than in the common infectious diseases. From scarlet fever and diphtheria females, aged 0-5 years, died, in the last ten years, at a rate about 5 per cent. lower than that of the males; from measles their advantage was as much as 10 per cent. From whooping-cough, on the other hand, their mortality was between 20 and 25 per cent. in excess, and this excess, at ages under 5, as shown in Table IV, has remained remarkably constant between 1861 and 1930. Watt's figures for Glasgow for 1783-1812 give a similar result. We do not know the exposed to risk, but the percentage ratio of female to male deaths (94 per cent. of which are under age 5) is 116. When a finer subdivision of ages is taken, this female excess, as has

* *Jour. of Hyg.*, Oct. 1932.

TABLE IV.

England and Wales. The Death-rate of Females at ages under 5 from Measles and Whooping-cough expressed as a percentage of the corresponding Death-rate of Males.

	Measles. 100 F./M.	Whooping-cough. 100 F./M.
1861-70	96	122
1871-80	94	121
1881-90	92	120
1891-1900... ..	93	122
1901-10	93	124
1911-20	92	127
1921-30	89	123

been shown in the Registrar-General's reports, is curiously distributed. At ages 0-3 months (*vide* Table V) the female deaths are 10 to 17 per cent. in excess of the male deaths; at ages 3-6 months this excess nearly disappears and the sexes show very little difference; at ages 6-12 months the excess reappears at about the same level as in the first three months of life. After one year of age the female excess rises and is approximately 50 per cent. from ages 2 to 5 years.

TABLE V.

England and Wales. Deaths of Females from Whooping-cough expressed as a percentage of the corresponding Deaths of Males.

			Months.			Years.			
			0 3.	3 6.	6-12.	1-.	2-.	3-.	4-5.
1891-1900			113	104	110	130	141	153	151
1901-10			114	102	113	130	143	153	168
1911-20			117	102	113	131	146	153	154
1921-30			111	98	109	126	146	149	135

*England and Wales. Death-rates of Females from Whooping-cough expressed as a percentage of the corresponding Death-rates of Males.**

1921-30	116	101	112	129	150	153	135
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* At 0-3 months deaths per 1,000 births; at 3-6 and 6-12 months deaths per 1,000 survivors; at higher ages death-rates as calculated in Table IIA.

These female/male ratios are naturally affected somewhat by the fact that they are based upon the actual *deaths*. Owing to the larger number of male births the ratio at 0-3 months must be an understatement; the effect upon the ratios in the later age groups depends

upon the extent to which the general higher male mortality corrects the higher percentage of male births. That the general run of the ratios over the age groups is very little altered by the use of *death-rates* is shown in the last line of Table V. These death-rates are somewhat roughly calculated, but it is to be observed that they are not required absolutely but only relatively in the female/male ratio. The ratios are all slightly higher, as would be expected, but their sequence is not materially changed.

Urbanization, according to the figures in Table VI, does not noticeably affect the *relative* course of mortality as regards the two sexes.

TABLE VI.

England and Wales. Administrative Areas. Female Deaths from Whooping-cough as a percentage of Male Deaths.

		Age in years.			
		0-.	1-.	2 .	3-5.
1911-20 {	All Urban Districts ...	112	131	145	149
	Rural Districts ...	111	135	149	183
1921-30 {	All Urban Districts ...	108	125	146	
	Rural Districts ...	105	134	144	

Young and Russell tested this point by, *inter alia*, correlating the standardized death-rates from whooping-cough for male and female children under 5 years of age with the density of population (as judged by the criterion number of rooms per person) in the metropolitan boroughs of London. The mortality was definitely correlated with the density (-0.76 and -0.78 for males and females respectively), "a higher mortality accompanying increased congestion and the unfavourable conditions of life and increased opportunities for infection which this connotes, but the association is equivalent in the children of the two sexes; the females are not more vulnerable on exposure to unfavourable conditions of life."* Similarly, they conclude that the level of the female excess shows no tendency to a particular geographical distribution nor relation to industrial centres. The same broad conclusions can be reached by a consideration of the female/male ratio for whooping-cough deaths (at ages 0-5) over the past three-quarters of a century. In 1861-70 the ratio was 122; in 1921-30 it was 123. In the latter period the whooping-cough death-rate was only one-third of its level in 1861-70 (*vide* Table II),

* "Sexual Differentiation in Susceptibility to and Mortality from Whooping-cough in Children under five years," *Brit. Jour. of Children's Diseases*, 1927, XXIV, 165-84.

but the improvement in the two sexes is practically identical. Increasing urbanization, improvements in the standard of living, falling birth- and death-rates, the alterations in age constitution and the many other environmental changes of the last seventy years have had no effect upon the ratio. In addition, the phenomenon is apparent in such widely separated areas as Australia and Holland, Denmark and the United States. No simple environmental influence, therefore, seems adequate to explain it.

TABLE VII.

Case Incidence and Case Mortality from Whooping-cough according to Sex.

		Age in years.						
		0-.	1-.	2-.	3-.	4 5.	5-10.	10 and over.
GLASGOW,* 1925-26	Notified Cases	Males 1,111 Females 1,181 100 F./M. 106	1,088 1,080 99	983 1,109 113	1,041 1,198 115	875 1,023 117		
	Case Fatality per 100	Males 15.1 Females 15.0 100 F./M. 99	11.0 14.1 128	4.2 1.3 102	1.0 1.1 110			
ABERDEEN,† 1891-1900	Attack rate per 1,000 of population at each age	Males 65.7 Females 73.6 100 F./M. 112	68.6 79.0 115	66.5 80.8 122	58.7 70.9 121	49.7 59.4 120		
	Case Fatality per 100	Males 13.1 Females 12.0 100 F./M. 92	9.6 10.6 110	3.1 3.5 113	2.0 1.9 95			
ENGLAND,‡ PRE-SCHOOL CHILD ENQUIRY, 1925-28	Number of Children	Males 891 Females 91 100 F./M. 71	622 638 110	635 613 66	559 547 38			
	Case Incidence per 1,000	Males 98 Females 79 100 F./M. 81	161 136 84	104 119 114	68 73 107			
U.S.A.,§ MARYLAND, 1926-30 (white children only)	Notified Cases	Males 228 Females 217 100 F./M. 108	118 189 128	174 211 121	198 212 107	205 214 104	771 786 102	110 201 144
	Deaths	Males 107 Females 117 100 F./M. 109		113 107 117 109			3 10 333	1 2 200
		0-4.	5-9.	10-11.				
U.S.A.,|| HAGERSTOWN, 1921-24	Number of Cases	Males 115 Females 94 100 F./M. 122.1	78 64 71.4	7 5 8.3				
	Annual rate per 1,000	Males 112.5 Females 92 100 F./M. 92	63.3 89 70	5.8				

* Report of the Medical Officer of Health for the City of Glasgow, 1926.

† "Whooping-cough: Its Prevalence and Mortality in Aberdeen." By James S. Laing and Matthew Hay. *Public Health*, Vol. XIV, p. 584, 1901-2.

‡ Ministry of Health Inquiry into the Health of the Pre-school Child. Annual Report of the Chief Medical Officer for 1931. Appendix F.

§ Annual Reports of the State Board of Health of Maryland, 1926-30.

|| U.S.A. Public Health Report, Vol. 43, 1928, No. 21, p. 1259. Hagerstown Morbidity Studies, No. IX. "Sex Differences in the Incidence of Certain Diseases at Different Ages," by E. Sydenstricker.

TABLE VII.—*continued.*

CANADA, ¶ LONDON 100 Females attacked/ Males attacked. 100 children at each age 0-14 inclusive (from past history cards).	Chicken pox. 106	Diph- theria. 114	German Measles. 116	Measles. 102	Mumps. 101	Scarlet Fever. 111	Whooping- cough. 105
DENMARK **	Ages 15 and over.						
1921 Census	{ Number of		{ Males		...	...	1,079,680
			{ Females		...	...	1,172,101
			{ 100 F./M.		...	...	109
1925-27	{ Number of whoop- ing-cough cases		{ Males		...	...	660
	{ notified		{ Females		...	...	894
			{ 100 F./M.		...	...	135
HOLLAND ††	13,590 School-children { 117 females gave history of past attack per 100 males.						

¶ "A Census of the Contagious Diseases of 8,786 Children." By E. C. Henderson. *Amer. Journal Pub. Health*, 1916, p. 371.

** Census of Denmark, 1921, and Medical Reports (Medicinalberetning for den Danske Stat), 1925 to 1927. Below age 15 the cases are not differentiated by sex.

†† "The Control and Prevention of Whooping-cough." By B. H. Sajat and J. V. Gelderen. *The Medical Officer*, Oct. 20, 1923, Vol. 30, p. 181.

This female excess of mortality may obviously arise in two ways. (1) The case incidence on the two sexes may be equivalent, but the case fatality be higher amongst the females. (2) The case incidence may be higher on the females and the case fatality for the sexes not differ. A combination of the two may, naturally, be possible. Females may have both a higher case incidence and a higher case fatality. General notification of whooping-cough has never been adopted in this country, and statistics of its prevalence are extremely scarce. Where it has been notifiable, as in some parts of the registration area of the United States, in Denmark and in South Australia, the cases are not differentiated with regard to sex or notification is obviously deficient. The most satisfactory statistics are those derived from Glasgow, where the notification of whooping-cough was made compulsory in 1925-6, and Aberdeen, where it was compulsorily notifiable from 1882-1902 (an analysis of these latter statistics having been made by Dr. James Laing and Professor Hay). In Table VII I have gathered together all the evidence of any value as to case incidence and case fatality with regard to sex that I have been able to find. This table does not include the valuable data for four London boroughs analysed by Stocks and published after this study had been completed.* He finds the female/male ratio of cases to be about 105 up to 4 years of age, rising to 120 by the eighth year and 150 by the tenth year.

Considering first the incidence, the figures for Glasgow and for Aberdeen both show a uniformly higher case-rate amongst females

* *Lancet*, 1933, Jan. 28th and Feb. 4th, and *Jour. of Hyg.*, Oct. 1932.

(there is one exception in the ten rates, at ages 1-2 in Glasgow, when the ratio is 99). The excess appears to be higher after age 2 years than before that age. In the pre-school child figures no excess at all is found before age 2 is reached. At ages 0-2 there is, in this enquiry, actually a lower incidence amongst females, but the number of cases, it must be noted, is not very large. The Danish statistics for age 15 and over show a distinctly higher incidence amongst females, as do also the case histories from Holland. An objection to the latter form of evidence is that if females tend to suffer more severely from whooping-cough, cases are more likely to be remembered amongst them than amongst the males. The case histories from Canada only show a small female excess (5 per cent.) which is smaller than the corresponding excesses in diphtheria, German measles and scarlet fever. The only figures which fail to show some excess incidence amongst females are those obtained in the Hagerstown morbidity studies (U.S.A.). At ages 0-10 the female case-rate is about 10 per cent. below that of the males, although the mortality in the United States generally is higher amongst females, and the case incidence in Maryland is higher amongst females. (The case mortalities in Maryland at the younger ages suggest that notification is certainly deficient. Whether this affects the sexes differentially it is impossible to say. If the female sex react more unfavourably to the disease they might tend to be more reported.) Apart from this one exception (the Hagerstown data) the statistics available certainly suggest a general *higher susceptibility of females* to clinical attack, especially after age 2.

As regards case fatality, the only direct evidence presented is in the figures for Glasgow and Aberdeen and the somewhat dubious figures for Maryland. It will be seen that in the Scottish towns in five of the eight groups the female case mortality exceeds that of the males. Before age 1 is reached, however, the females show no signs of being more likely to die. In Maryland the ratio of deaths in relation to ratio of cases is excessive after age 5 but not before (after age 5 the deaths are very few). Godfrey finds in New York State a case fatality rate of 2.72 per cent. for males and 2.87 per cent. for females at all ages.*

Some information is available from hospital statistics, but such statistics are always difficult to interpret and in this case they do not give consistent results. Young and Russell show that the case mortality of *males* at ages 0-5 is 5 per cent. *higher* than the rate for females (Belvidere Fever Hospital, Glasgow, 1885-1909). On the other hand, in the M.A.B. Hospitals (1911-14) the *females* have an excess mortality at the same ages of 8 per cent. At

* *New York State Jour. Med.*, 1928, XXVIII, 1410.

individual ages the sex ratios do not tally either, so that it seems impossible to draw any conclusions from these data. Returning to Table VII, indirect evidence of the relative case mortality is provided by the fact that the various excess case *incidences* shown are distinctly below the female excess *mortality* shown for a larger number of deaths, as in Table VI. For England and Wales the female deaths exceed those of males by about 20 to 25 per cent. at ages 0-5; the female cases shown in the various figures of Table VII are not in excess to that extent, while Stocks, for the London boroughs, gives a ratio at ages up to 4 years of only 105. Owing to the absence of sufficient data the evidence is still unsatisfactory, but the general conclusion seems to be that females are more susceptible to attack and possibly, judging by the figures from the Scotch towns, after the first year of life, also succumb somewhat more easily to attack. In other words, it is suggested that both factors are involved in producing the higher death-rate amongst females.

There is no indication that the female excess varies in years of high or low mortality. Table VIII shows that the ratios differ extremely little between years when the number of deaths was 40 per cent. above the average and years when they were equally below the average.

TABLE VIII.

England and Wales. Ratio of Female to Male Deaths from Whooping-cough at ages under 5 years in years of high and low Mortality.

Period.	Mean Annual Number of Deaths.		100 Females/ Males.
	Males.	Females.	
1860-69	4,751	5,787	122
High Mortality, 1861, 1862, 1866, 1867 ...	5,701	6,876	121
Low Mortality, 1860, 1864, 1865, 1868 ...	3,779	4,636	123
Average Mortality, 1863, 1869	4,796	5,910	123
1911-20	2,794	3,498	125
High Mortality, 1912, 1914, 1915, 1918 ...	3,723	4,574	123
Low Mortality, 1917, 1919, 1920	1,605	2,063	129
Average Mortality, 1911, 1913, 1916 ...	2,743	3,498	128
1921-30	1,940	2,336	120
High Mortality, 1922, 1925, 1929	2,715	3,317	122
Low Mortality, 1928, 1930	1,082	1,323	122
Average Mortality, 1921, 1923, 1924, 1926, 1927	1,819	2,152	118

The same point is, of course, illustrated in Table IV, which shows that the female/male ratio has remained approximately con-

stant over the last three-quarters of a century in spite of the enormous fall in the death-rate.

This is equally true of the ratios at the different ages, as is shown in Table VIIIA and Fig. (ii). There is a slight suggestion

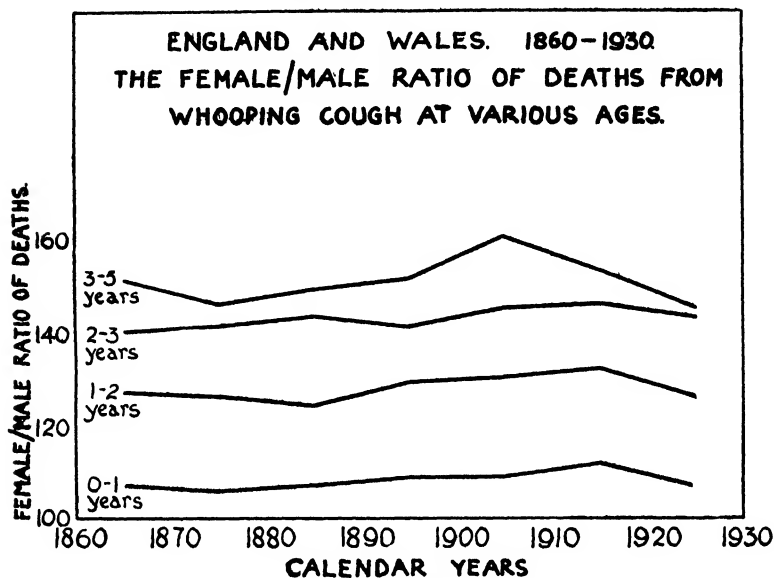


FIG. (ii).

that the females at each age suffered disproportionately between 1900 and 1920, since the female/male ratios are slightly higher in these years than in the earlier years, followed by a fall in the 1920-29 period, when whooping-cough mortality was at its lowest.

TABLE VIIIA.

England and Wales. The Female/Male ratio of Deaths from Whooping-cough at various ages. 1860-1930.

Period.	Age in years.			
	0-1.	1-2.	2-3.	3-5.
1860-69	107	127	140	151
1870-79	106	126	141	146
1880-89	107	124	143	149
1890-99	109	129	141	151
1900-09	109	130	145	160
1910-19	112	132	146	153
1920-29	107	126	143	145

But, on the whole, the differences are very small, and do not suggest that the factors responsible for the fall in the death-rates at each age (as shown in Table IIA) have differentially affected the sexes in any very material way.

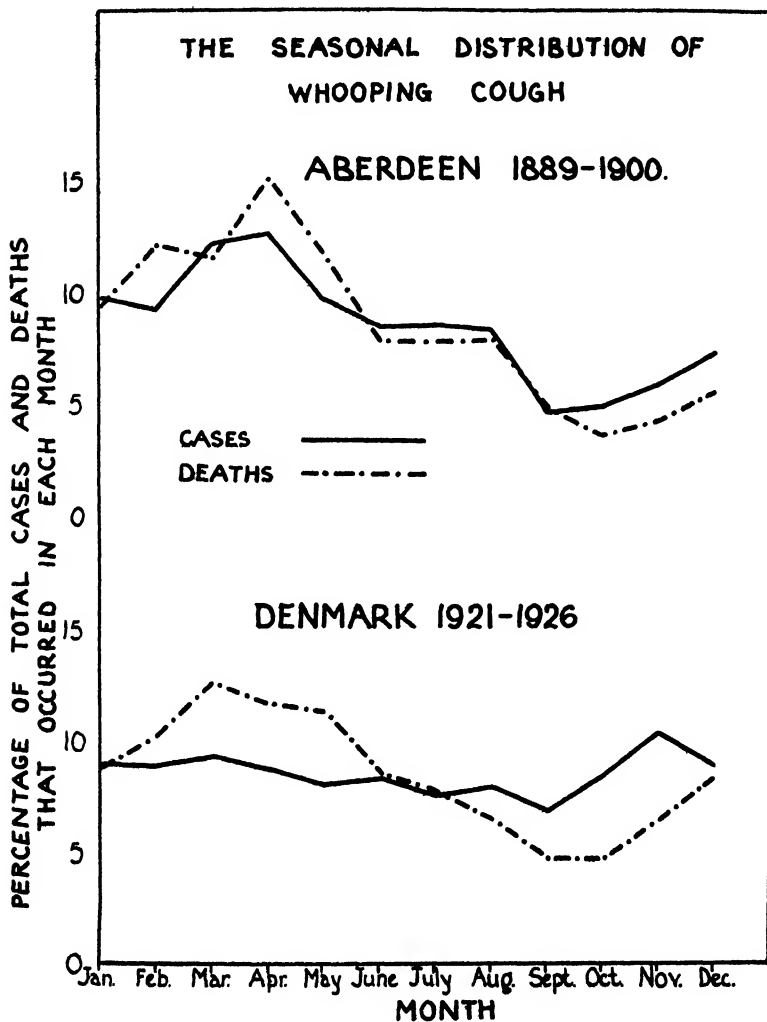


FIG. (iii).

With regard to seasonal variation it is reported in the Fourth Epidemiological Report of the Health Section of the League of Nations (1926), that "while the number of the whooping-cough cases is little influenced by seasons, the mortality attributed to it

TABLE IX.
Whooping-cough Incidence and Mortality. Seasonal Influences.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
DENMARK, 1921-26	Cases 10,029 8.9 % of total... Deaths 202 8.7 % of total...	9,882 8.8 235 10.1	10,307 9.2 289 12.5	9,045 8.0 266 11.5	8,945 7.9 259 11.2	9,073 8.1 194 8.4	8,298 7.4 176 7.6	8,759 7.8 145 6.3	7,584 6.7 107 4.6	9,348 8.3 107 4.6	11,475 10.2 145 6.3	9,837 8.7 193 8.3	112,582 100.0 2,318 100.1
ABERDEEN, 1889-1900	Cases 1,628 9.7 % of total... Deaths 82 9.3 % of total...	1,524 9.1 106 12.0	2,028 12.1 102 11.5	2,092 12.5 133 15.0	1,582 9.5 103 11.6	1,390 8.3 67 7.6	1,407 8.4 67 7.6	1,361 8.1 68 7.7	758 4.5 41 4.6	787 4.7 31 3.5	956 5.7 37 4.2	1,210 7.2 49 5.5	16,723 99.8 886 100.1
CONNECTICUT, 1919-28	Cases* 11.1 % of total...	9.3	10.1	8.0	8.3	7.9	8.8	7.2	6.0	5.8	8.1	8.5	27,679 99.1
ENGLAND and WALES, 1921-29	Males 2,080 10.9 % of total... Deaths 100 11.2 % of total... Females 2,583 11.2 % of total... Deaths 124 12.4 % of total... Male deaths	2,854 14.9 3,370 14.6 118	3,047 15.9 3,384 14.6 111	2,349 12.3 2,773 12.0 118	1,824 9.5 2,226 9.6 122	1,297 6.8 1,549 6.7 119	1,113 5.8 1,372 5.9 123	928 4.9 1,243 5.4 134	897 4.7 1,165 5.0 130	698 3.6 850 3.7 122	803 4.2 1,003 4.3 125	1,234 6.5 1,623 7.0 132	19,124 100.0 23,141 100.0 121

* Read from chart of seasonal distribution. Absolute figures and deaths not given.

shows marked seasonal fluctuations." This conclusion is based upon the Danish figures shown in Table IX. That it is certainly not universally true is shown by the statistics for Aberdeen and for Connecticut. In the former (Table IX and Fig. (iii)) the seasonal variation in cases follows quite closely the variations in mortality. In the latter there is similarly a distinct seasonal change in incidence.

The Registrar-General (England and Wales) has shown in his report for 1925 that in both measles and scarlet fever the seasonal distribution of deaths has changed considerably in recent years. It seemed of interest to see whether whooping-cough too showed any alteration in its distribution of deaths over the year. In Table IXA are given, for London, the proportion of the total deaths in the year that fell in each four-weekly period between 1840 and 1930. These figures suggest that with the falling whooping-cough death-rate there has been some tendency for the deaths to become more concentrated in the early months of the year, February to May roughly, and for proportionately less deaths to be recorded in the last months of the year, September to December.

TABLE IXA.

The Seasonal Distribution of Deaths from Whooping-cough in London, 1840-1929. Percentage of total deaths falling in each four-weekly period.

Four-weekly period.

Period.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1840-69 ...	9.6	10.1	10.4	10.6	9.5	8.3	6.8	5.8	4.7	4.7	5.1	6.4	8.0
1870-89 ...	10.1	12.1	10.9	11.6	9.9	7.9	6.7	6.0	4.7	3.9	3.7	4.8	7.8
1890-1909 ...	10.3	10.7	11.1	11.9	10.7	8.5	6.8	6.2	5.4	4.5	3.2	4.3	6.6
1910-29 ...	9.8	14.3	14.4	14.5	11.4	7.4	5.5	4.3	4.0	3.8	2.7	3.0	5.1

Four-weekly periods grouped.

	1.	2-5.	6-9.	10-13.
1840-69 ...	9.6	40.6	25.6	24.2
1870-89 ...	10.1	44.5	25.3	20.2
1890-1909 ...	10.3	44.4	26.9	18.6
1910-29 ...	9.8	54.6	21.2	14.6

In the last section of Table IX examination is made of the effects of the seasonal variations in mortality upon the female/male ratio. The figures suggest that the female excess is least in the months of high mortality and greatest in the months of low mortality. The effect can be seen more clearly with the figures in the following form :—

Months.	Average Number of Deaths per Month.		100 F./M.
	Male.	Female.	
Feb. and March	2,950	3,377	114
Jan., April, May	2,084	2,527	121
June, July, Dec.	1,215	1,515	125
Aug., Sept., Oct., Nov.	832	1,065	128

The female excess is, according to this experience, not constant. It rises steadily from the months of highest incidence to the months of lowest incidence. Whatever factor it is causing the higher female mortality, it seems to be more apparent when, according to the Aberdeen figures, the disease is least prevalent than in the season when it is widely prevalent. Stocks, in figures for Greenwich, finds a higher female/male ratio of *cases* during February to September than during October to January, though the prevalence does not vary very greatly.

No satisfactory explanation of this female liability has yet been advanced. According to the Registrar-General (1922, Text, p. 59), "it has been suggested in America that the increase with age of the female excess is due to greater development of the larynx in boys, who are thereby better equipped for resistance to convulsive coughs." I am unable to trace this reference in American literature on the subject, but such an explanation has certainly been put forward by Creighton in his *History of Epidemics in Britain*. He writes: "The singular difference between the sexes in this respect is almost certainly related to the corresponding differences in the formation and development of the larynx, the organ which gives character, at least, to the convulsive cough of children. The expansion of the larynx, in boys, which becomes so obvious at puberty and remains so distinctive of the male sex, is one of those secondary sexual characters which begin to differentiate quite early in life, and are probably congenital to some extent. It is not known whether female children are more often attacked than males; but it is probable that they are predisposed both to acquire coughs of the convulsive suffocative kind and to have their lives shattered by the attack—for the same anatomical and physiological reasons, namely, the imperfect development of the posterior space of the glottis with the spasmodic closure by reflex action." Dr. Stevenson points out that this explanation "seems inconsistent with the existence of substantial excess of mortality amongst males from laryngitis, and from croup at the time when croup was of importance." Young and Russell also find difficulty in accepting this explanation. "So far as is known," they

write, "the differences in the larynx of female and male children at the ages when the incidence of the mortality from the disease is greatest, namely, under one year and from one to two years, are negligible. The larynx grows slowly and uniformly from birth up to the sixth year of childhood, when a cessation of growth takes place till puberty is reached. Up to this time the larynx in both sexes is essentially similar in its characters. Though the larynx and trachea in female children were slightly smaller than in the male, it is very improbable that such differences as might exist would influence the mortality from the disease." Actual measurements seem to be lacking except for adults, when considerable differences are noted. For instance, the following dimensions are given by Sappey.*

		Vertical Diameter.	Transverse Diameter.	Antero- posterior Diameter.	Circum- ference.
Mean dimensions of the larynx in eight adults (in millimetres).	Male ...	44	43	36	136
	Female	36	41	26	112

On the other hand, he says that "les variétés dépendantes de l'âge ne sont pas moins remarquables que celles inhérentes au sexe. A la naissance et dans les premiers mois qui la suivent, les diamètres vertical et transverse offrent une étendue de 15 à 18 millimètres, qui se réduit pour l'antéropostérieur à 10 ou 12. Ces trois diamètres s'allongent peu à mesure que le larynx se développe. Mais comme son évolution, bien que réelle, n'est pas proportionnelle à celle des autres organes, il faut arriver jusqu'à l'époque de la puberté pour voir les variétés sexuelles se prononcer."

Similarly it is stated in both Gray's and Cunningham's text-books of Anatomy that until puberty is reached the larynx in both sexes is similar in its dimensions.

It must be concluded on general grounds, therefore, that the hypothesis that the female excess mortality is due to differences in the larynx rests upon a slender basis.

Young and Russell likewise reject the theory that the difference in mortality is due to a sexual difference in sensitiveness of the nervous system. The evidence that female children have a less stable nervous system than male children will not, they say, bear serious investigation. "Such a view seems to rest mainly on the fact that at the later ages, *i.e.* from puberty onwards, chorea is more common and more fatal in the female sex than in the male. Exophthalmic goitre, a disease with associated nervous manifestations, is

* C. Sappey, *Traité d'anatomie descriptive*, 4th ed., 1889, pp. 365-7.

also more frequent and more fatal in females than in males. But the mortality from convulsions, the syndrome which is undoubtedly the best criterion of stability of the nervous system in children, is apparently greater in male than in female children, and the mortality from laryngismus stridulus, which may be a purely nervous affection, is also heavier in the former sex. The same relationship seems to hold for meningitis. The higher mortality in males than in females from these diseases which specially involve the nervous system would appear to refute the suggestion that the converse relationship should occur in whooping-cough through a sexual difference in sensitiveness in this region."

These authors finally consider the hypothesis that the special susceptibility of females is due "to innate differences in children of the two sexes in degrees of natural immunity to the bacillus of whooping-cough, and to the secondary complications that are so apt to follow infection by this organism."

In the Annual Report of the Registrar-General of England and Wales for 1911 the deaths from whooping-cough are tabulated according to the certified causes of death. Only one-quarter of the fatal cases were certified as dying of whooping-cough without any qualification or details of complications. One-half of them had respiratory diseases as contributory or secondary causes of death, and one-tenth had convulsions. Using these data Young and Russell show that the mortality amongst females at ages 0-5 years from broncho-pneumonia, pneumonia, bronchitis, respiratory diseases (as a whole), convulsions and measles *occurring as complications of whooping-cough*, invariably and uniformly exceeds the corresponding mortality of males; yet among the children dying from these causes *uncomplicated by whooping-cough* the death-rates in females are lower than in males. From this, and from their rejection of the other two hypotheses, they conclude that the only feasible explanation of the sex difference seems to be "that infection with the whooping-cough germ, though seldom fatal in itself, has apparently the power to modify in an unequal degree the powers of resistance of male and female children, rendering females more vulnerable than males to intercurrent respiratory infections and their sequelæ and to some other diseases." This explanation only leads back to the original problem, that females are more susceptible to whooping-cough and that we have no valid conception of the reasons why. It seems unlikely that the present vital statistics of deaths, and, infrequently, of cases, will enable a solution to be found. Possibly a close field-study of such factors as symptoms, complications, duration of disease and point of death might place the problem in a clearer light.

Paradoxes in the Mortality under one year of age.

Female/Male Ratio.—It was shown in Table V that after an initial high level at 0–3 months of age the excess mortality amongst females drops curiously in the second three months of life and then rises again to approximately its original level. This phenomenon consistently appears in each of the last four decades. It has also been observed in America.* A study of other principal causes of death under one year of age shows that although whooping-cough is the only one with a female excess, this course of the death ratios, *i.e.* the fall at 3–6 months, is not peculiar to whooping-cough. Table X shows that diphtheria also has a relatively high female/male ratio at ages 0–3 months, a fall at ages 3–6 months, and a rise to about its original level at 6–12 months. The figures suggest possibly a similar course for influenza and diseases of the larynx. On the other hand, other forms of respiratory disease, bronchitis and pneumonia, and, perhaps, tuberculosis, fail to show any fall in the ratio at ages 3–6 months; their tendency, which is shared by measles and diarrhoea and enteritis, is towards a female advantage in the first three months of life lessening with age. Deaths from congestion and pulmonary infarct show, somewhat interestingly, just the reverse process to whooping-cough and diphtheria—a relatively low ratio at 0–3 months, a rise at ages 3–6 months and a falling back at ages 6–12 months.

This might suggest some transference of deaths, though such a transference would have to be sex-differentiated. For instance, if, as seems possible, the female/male whooping-cough death ratio should be a continually rising one between age 0 and age 4 or 5, there are too many female deaths at ages 0–3 months and too few male deaths. To correct this to somewhere near equality would require a transference of at least 50 per cent. of the male deaths at ages 0–3 months from pulmonary congestion, and an increase by 50 per cent. of the female deaths from pulmonary congestion by a transference of whooping-cough deaths. It is not easy to accept such a large transference and one so sex-differentiated. In addition it would not account for the very similar course of the death ratios shown by diphtheria, influenza and, possibly, diseases of the larynx. Study of other causes of death, therefore, does not suggest that the phenomenon can be interpreted in terms of any statistical fallacy in death tabulation.

Another possible factor that suggests itself is the lower death-rate amongst female infants from premature birth. If a larger proportion of immature female infants survive birth, then they may more easily

* Registrar-General for England and Wales. Statistical Review for 1922, footnote to p. 59.

TABLE X.

England and Wales. Deaths of Females from Various Causes expressed as a percentage of the corresponding Deaths of Males.

Cause of Death.	Period.	Age in months.		
		0-3.	3-6.	6 12.
Whooping-cough	1911-20	117	102	113
	1921-30	111	98	109
Diphtheria	1911-20	79	70	78
	1921-30	82	70	75
Influenza	1911-20	67	65	74
	1921-30	72	62	71
Diseases of the Larynx Laryngismus stridulus and Laryngitis	1911-20	71	59	72
	1921-30	59	59	65
Tuberculosis (pulmonary, not acute)	1911-20	91	80	85
	1921-30	61	92	82
Tuberculosis (respiratory)	1911-20	91	80	85
	1921-30	61	92	82
Bronchitis	1911-20	72	75	81
	1921-30	70	74	78
Pneumonia	1911-20	68	70	75
	1921-30	71	70	73
Congestion and Pulmonary In- farct	1911-20	74	80	73
	1921-30	74	101	89
Measles	1911-20	73	80	83
	1921-30	61	62	79
Diarrhoea and Enteritis	1911-20	66	78	85
	1921-30	60	69	78
All causes, less Whooping-cough	1911-20	73	76	80
	1921-30	72	70	76

succumb in the first stages of life to other causes of death than the more selected males. But on this hypothesis it is difficult to explain why whooping-cough should single out the weaker females and such diseases as diarrhoea and enteritis show a low female/male sex ratio in the first three months of life. One would certainly expect some other causes of death to be excessive as well as whooping-cough. In addition, examination of the female/male ratios for the forty years 1891-1930 shows no relationship between the relative number of female deaths from prematurity at 0-3 months and the corresponding relative number of whooping-cough deaths (for all England and Wales). The female/male ratio of premature deaths varies exceedingly little. The mean for the forty years is 76 female deaths

per 100 male deaths, the range being from 73 to 81 with a coefficient of variation of 2.2. The whooping-cough ratio fluctuates from 93 to 133 round a mean of 114, with a coefficient of variation of 8.9. The correlation between the two ratios is nil (+0.03). The premature death ratio has fallen between 1891 and 1930, while the whooping-cough ratio shows no consistent movement. If time be kept constant correlation between the two ratios is still absent (-0.01).

Another possible hypothesis was that a high female/male ratio at ages 0-3 months implied an elimination of the female susceptibles so that in the following age period fewer susceptibles, relative to the males, remained. If that were so, a high female/male ratio at ages 0-3 months should be followed by a low ratio at 3-6 months, and a low ratio at 0-3 months should be followed by a relatively high ratio in the 3-6 months' age group. Using the statistics for England and Wales for 1891 to 1930, the correlation actually found between the ratios at these ages is +0.10; for the Registration Counties in 1901-10 (40 in number, grouping small counties) it is -0.04, correlations opposite in sign and both insignificant.

The course of the female/male ratios over these ages does not differ appreciably between the various types of administrative areas. Table XI shows that it is apparent both in the rural and the urbanized areas, and judging by both periods of years there is no relationship between type of area and the level of the ratios.

TABLE XI.

Administrative Areas. Deaths of Females from Whooping-cough expressed as a percentage of the corresponding Deaths of Males in the first year of life.

Period.	Area.	Age in months.		
		0-3.	3-6.	6-12.
1901-10	{ London	116	107	115
	{ Urban Counties*	113	101	114
	{ Rural Counties*	122	93	112
1911-20	{ London	113	102	107
	{ County Boroughs	119	95	113
	{ Other Urban Districts	122	107	117
	{ Rural Districts	111	105	113

* As defined in the Registrar-General's Decennial Supplement for 1901-10, p. x.

Similarly, the ratios do not vary appreciably between legitimate and illegitimate infants (Table XII). There is, perhaps, a tendency for the female disadvantage at 0-3 months to be less acute amongst

the illegitimate babies, and their improvement in the following age group to be more distinct; but the total number of deaths from whooping-cough amongst the illegitimate is not large at these ages and these differences cannot be stressed.

No explanation of these curious ratios is therefore available.

TABLE XII.

England and Wales. Death-rates (per 1000 births) of Females from Whooping-cough expressed as a percentage of the corresponding Death-rates of Males. Differentiating Legitimate and Illegitimate Births.

Period.			Legitimate Infants. Deaths per 1,000 births.			Illegitimate Infants. Deaths per 1,000 births.		
			0-3 months.	3-6 months.	6-12 months.	0-3 months.	3-6 months.	6-12 months.
1911-20	Males ...	...	0.69	0.79	1.81	0.58	1.06	2.13
	Females ...	...	0.85	0.84	2.14	0.68	1.02	2.31
	100 F./M.	...	123	106	118	117	96	108
1921-30	Males ...	...	0.57	0.60	1.42	0.47	0.85	1.75
	Females ...	...	0.66	0.62	1.62	0.50	0.76	2.06
	100 F./M.	...	116	103	114	106	89	118

Illegitimate/Legitimate ratio. Table XII reveals another of the paradoxes of whooping-cough mortality. Contrary to the general rule of mortality, the illegitimate infants die, in the first three months of life, at a lower rate than the legitimate. The position can, perhaps, be seen more clearly in Table XIII, where the death-rates of the legitimate have been expressed as percentages of the death-rates of the illegitimate. At 0-3 months the legitimate infants suffer a mortality 20 to 25 per cent. in excess of that experienced by the illegitimate. At 3-6 months and 6-12 months the customary excess mortality of the illegitimate appears.

TABLE XIII.

England and Wales. Death-rates of Legitimate Infants from Whooping-cough as percentages of the corresponding Death-rates of Illegitimate Infants.

Period.			Males.			Females.		
			0-3 months.	3-6 months.	6-12 months.	0-3 months.	3-6 months.	6-12 months.
1906-10	...	...	118	81	90	124	99	87
1911-20	...	...	119	75	85	125	82	98
1921-30	...	...	121	71	81	132	82	79

The Registrar-General using a smaller experience suggests that the significance of this peculiarity is "very doubtful."* Yet the ratios shown in Table XIII are constant for both sexes over a period of a quarter of a century. Commenting further on these ratios the Registrar-General says, "It seems strange that the illegitimate should be relatively protected from the whooping-cough risk during the first three months of their life, especially as mortality in these cases notoriously varies in accordance with efficiency of nursing and care generally. Possibly the lesser risk, in the case of the illegitimate, of domestic infection by a brother or sister may provide the explanation."* It is difficult to reconcile this explanation with the fact that, whereas in 1921-30 the excess mortality from whooping-cough of legitimate over illegitimate infants was roughly 25 per cent., the mortality from measles and diphtheria (combined, owing to the small number of deaths) was amongst the legitimate only *half* that of the illegitimate. One would expect the lack of domestic infection to have played some part in the incidence of these infectious diseases as well. It seems curious too that the lack of domestic infection should only operate at 0-3 months, and that illegitimate infants should at ages 3-6 months be sufficiently exposed to outside risks for the balance of legitimate/illegitimate deaths to right itself (removal of the infant to a home at the later age might be an explanation). A further point of objection is that although between 1911-13 and 1928-30 the birth-rate fell by approximately one-third, the whooping-cough death-rate at 0-3 months did not fall significantly more amongst the legitimate than amongst the illegitimate infants (37 per cent. against 29 per cent.). Reduction of domestic infection due to smaller families would, it might be thought, show to more advantage amongst the legitimate. Although there is some advantage, the advantage is certainly not very distinct. These reasons suggest that lack of a brother or sister as a source of infection is not an adequate explanation of this lower death-rate amongst the illegitimate at the beginning of life, and again no explanation of the phenomenon is available.

Rural/Urban ratio. There is one further point in connection with the mortality at 0-3 months which deserves comment. Table XIV shows that in this particular age group, again contrary to the general rule, the mortality in the *rural* districts is in excess of the mortality in the *urban* districts. This is true both of legitimate and illegitimate offspring. The excess disappears at 3-6 months and the urban mortality becomes progressively more unfavourable.

* Registrar-General's Statistical Review of England and Wales, 1922, Text, p. 61.

TABLE XIV.

England and Wales. The Whooping-cough Death-rates under 1 year of age (per 1,000 births) in Urban and Rural Districts, distinguishing Legitimate and Illegitimate Infants.

		URBAN DISTRICTS.			RURAL DISTRICTS.		
		Months.			Months.		
		0-3.	3-6.	6-12.	0-3.	3-6.	6-12.
1911-20	Deaths per 1,000 Legitimate Births ...	0.74	0.81	2.04	0.91	0.83	1.67
	Rural rates as % of urban rates ...				123	102	82
	Deaths per 1,000 Illegitimate Births ...	0.60	1.10	2.46	0.72	0.84	1.34
	Rural rates as % of urban rates ...				120	76	54
1921-30	Deaths per 1,000 Legitimate Births ...	0.58	0.62	1.60	0.73	0.57	1.19
	Rural rates as % of urban rates ...				126	92	74
	Deaths per 1,000 Illegitimate Births ...	0.46	0.87	2.07	0.56	0.61	1.29
	Rural rates as % of urban rates ...				122	70	62

The published data do not allow the sexes to be differentiated but the rural excess cannot be the result of a greater preponderance of female children (with their heavier mortality) in those areas. Rather is there an excess of male babies in the rural districts, as is shown by the following sex ratios at birth.

Sex ratio at birth (M./F. \times 1,000).

					Urban Districts.	Rural Districts.
1911-20	{ Legitimate	...	...	...	1,043	1,048
	{ Illegitimate	...	...	...	1,041	1,052
1921-30	{ Legitimate	...	...	...	1,045	1,048
	{ Illegitimate	...	...	...	1,041	1,041

The suggestion that the rural excess might be the result of increased domestic infection due to larger families is nullified by the fact that it is nearly equally apparent for illegitimate children. We are thus faced with three distinct anomalies with regard to whooping-cough in the first three months of life. The female infant responds less favourably than the male; the legitimate infant responds less favourably than the illegitimate; the infant in rural

surroundings responds less favourably than the infant in urban surroundings. It seems plausible to suppose that some single explanation would account for these differences, and that the most likely explanation lies in some selective force affecting the survivors. If the premature death-rate be regarded as a measure of selection, in the sense that the lower is this death-rate the weaker on the average are the survivors, it will be seen that this does operate in the right direction in each case. The death-rate from premature birth is lower amongst females than males, amongst illegitimate than legitimate infants, in rural areas than urban areas. On the other hand, it has already been shown that there is apparently no connection between the height of the female/male whooping-cough ratio and the height of the corresponding premature birth ratio. Similarly the figures (for legitimate infants) in Table XV do not suggest any relationship between the death-rates from premature birth and from whooping-cough in urban and rural areas.

TABLE XV.

*Deaths per 1,000 Births (legitimate) from Premature Birth and Whooping-cough.**

		London.	County Boroughs.	Other Urban Districts.	Rural Districts.
1911-20	Deaths at 0-1 month per 1,000 births from premature birth	15.37	18.61	16.89	16.50
	Deaths at 0-3 months per 1,000 births from whooping-cough	0.63	0.74	0.77	0.90
1921-30	Deaths at 0-1 month per 1,000 births from premature birth	12.79	17.27	15.98	15.84
	Deaths at 0-3 months per 1,000 births from whooping-cough	0.49	0.59	0.60	0.73

* These rates are the unweighted averages of the annual rates. In previous tables weighted averages were used, but it was found that extremely little difference resulted.

As regards county boroughs, other urban districts and rural districts there is a suggestion of rising whooping-cough rates in conjunction with falling premature birth-rates, but the movements are certainly not proportional. In addition, London does not fit into the picture at all. It has the lowest mortality from prematurity and yet the lowest mortality from whooping-cough. On the whole the whooping-cough death-rate seems to fall with increasing urban-

ization and the prematurity rate does not rise correspondingly. Lack of medical attention in the more scattered areas might fit these facts, but it cannot account for the female/male and legitimate/illegitimate ratios. It seems impossible to frame any hypothesis of differential exposure or inherited immunity. I am entirely at a loss to suggest any other explanation of these three paradoxes, which, it does not seem unreasonable to suggest, must be related.

Urbanization and Whooping-cough Mortality.

The general question of the effects of urbanization upon whooping-cough mortality is worth further consideration. Apart from the discrepancy already observed at ages 0-3 months, the rural experience in England and Wales is uniformly more favourable than the urban. The figures for recent years are given in Table XVI, which shows that the mortality in each age group is highest in the county boroughs and lowest in the rural districts.

TABLE XVI.

Mortality from Whooping-cough during 1923-27 in Different Classes of Administrative Area.

	Rates per 1,000 living. Age in years.			Rates per cent. of those for England and Wales.		
	0-1.	1-2.	2-5.	0 1.	1-2.	2-5.
England and Wales ...	2.89	2.00	0.43	100	100	100
London ...	2.76	2.07	0.46	96	104	107
County Boroughs ...	3.19	2.54	0.53	110	127	123
Urban Districts ...	2.73	1.78	0.39	94	89	91
Rural Districts ...	2.70	1.41	0.30	93	71	70

This increasing mortality with urbanization is not uniformly to be met with. According to the statistics of the Metropolitan Life Insurance Company of the U.S.A., the crude mortality from whooping-cough in rural portions of States was, in 1914-17, about 20 per cent. in excess of the mortality in the cities (figures quoted by the Registrar-General for England and Wales in the annual report for 1922). In Denmark in 1925-27 the crude mortality of the rural districts was one-third higher than that of the towns and the case incidence 10 per cent. higher (figures extracted from Medicinalberetning for den Danske Stat for each year 1925-27).

The English figures show that the advantage of the rural districts is largely concentrated upon ages over 1 year, and that in the first year of life the mortality differs but little from that of the urban administrative areas. This phenomenon, to which the Registrar-

General has drawn repeated attention, can be shown clearly in the following form.

TABLE XVII.

England and Wales. Whooping-cough Deaths under 1 year of age per cent. of those at all ages in Administrative Areas. 1920-30.

	1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.	1929.	1930.
London ...	45	43	33	47	38	43	44	41	44	38	48
County Boroughs ...	44	47	40	42	41	42	45	40	45	36	46
Urban Districts ...	53	53	43	47	46	47	45	44	48	43	45
Rural Districts ...	60	59	50	51	49	51	54	49	54	49	53

The increasing percentage of early deaths with decreasing urbanization is a decidedly stable characteristic of the epidemiology of the disease. It is equally to be observed three-quarters of a century ago, when the death-rate from whooping-cough was three times as high. Table XVIII shows that for the registration districts the proportion of deaths under 1 year of age rises extraordinarily steadily with decreasing density of population, and that the proportion of male deaths in infancy exceeds those of females by 5 or 6 per cent.

TABLE XVIII.

England and Wales. Whooping-cough. Deaths under 1 year of age as per cent. of those at ages under 5 years, in registration districts grouped according to density. 1861-71.

Number of Districts.	Number of acres per person.	Deaths from whooping-cough under 1 year as percentage of those under 5 years.	
		Male.	Female.
29 (London)	0.02	39	34
23	Under 0.1	40	34
81	0.1-1	47	41
86	1-2	50	45
97	2-3	52	46
112	3-4	54	46
91	4-5	56	49
39	5-6	57	50
64	6 and over	57	51
Total 622.	—	46	40

The cause certainly cannot lie in there being different proportions in the age group 0-1 in the exposed to risk, since the denser districts have slightly *higher* proportions of children under 1 year of

age (23 per cent. in the three groups with highest density against 21 per cent. in each of the rural areas with more than 2 acres per person). This particular characteristic of the disease is not shown by measles. The latter acts according to "expectation," viz. the more the "overcrowding" the earlier the liability to attack and death. "The effect of sparseness of population in delaying infection by measles is evident, for though there are no national records of the ages of children attacked, it may be assumed with confidence that where attacks occur earliest in life the proportion of deaths during the first two years will be greatest. As the differential fatality of measles for young children is well known, the lower mortality of the rural districts must be largely explained by later infection." * Yet for whooping-cough in rural areas there must be a relatively earlier age of infection and/or a higher case mortality in the first year of life. An earlier age of infection in more sparsely occupied districts seems difficult to explain, unless, as the Registrar-General has suggested, it might be due to larger families in the rural areas and therefore increased exposure of younger members. That rural families are somewhat larger than urban is shown by the 1911 census volume on fertility. But the difference is not very large. The extreme variation lies between Wales, with a high fertility, and the South of England, with a low fertility. Yet in these two areas the proportion of whooping-cough deaths at age 0-1 does not, in 1921-30, differ significantly. The proportions are as follows :—

		Wales.	South.
County Boroughs	... ..	47	48
Urban Districts	... ..	49	51
Rural Districts	... ..	56	55

Considering that Wales shows a higher fertility in each type of area the figures suggest no relationship between size of family and percentage of whooping-cough deaths under 1 year. From a study of the notification records in the U.S.A., Fales concluded for a group of infectious diseases, of which whooping-cough was one, that "the risk of attack in the earlier ages is greatest, relative to that in the older ages, in the large cities; the difference in risk between younger and older children tending to become less pronounced as one proceeds to the small cities, villages and open country. In other words, these diseases tend to be less distinctly 'diseases of childhood' in rural

* Registrar-General for England and Wales. Statistical Review for 1929, Text, p. 33.

districts than in cities." * It is impossible to decide without notification of cases whether, *per contra*, the case mortality is higher in the rural areas in the first year of life. The Danish figures previously quoted suggest that in that country the case mortality is higher in the rural areas, since the crude mortality of those areas was one-third in excess of that of the towns, while the case incidence was only 10 per cent. in excess. But it may be that notification of cases is less complete in the country districts. Considering what factor might be productive of a relatively excessive mortality at ages 0-1 in the rural areas, there might be suggested a relative absence of medical attention at an age when the mortality is normally at its highest. On the other hand, I took, for the years 1891-1900, the following three variables—(a) density, as measured by percentage of tenements of fewer than five rooms with more than two persons to a room; (b) whooping-cough deaths under 1 as a percentage of similar deaths under 5; (c) number of children under 1 as percentage of children under 5. Correlating density with percentage of whooping-cough deaths under 1, keeping percentage of children under 1 constant, gave for the London registration districts a coefficient of -0.3 . A similar coefficient was found for the highly urbanized counties of Cheshire and Lancashire. These coefficients suggest that a similar relationship between density and proportion of early deaths is apparent even in highly urbanized areas, and it seems impossible to believe that medical attention was less available, in 1891-1900, in the less crowded of the districts of London or the less crowded towns of the north-western counties than in the more crowded. A more reasonable suggestion seems to be that of the Registrar-General (in the 1929 Annual Report), that the risk of death from whooping-cough is much the same in all classes of area during infancy, but becomes considerably less in the country than in the town during and after the second year. The total deaths being, therefore, lower in the rural districts, the deaths in the first year of life must form a larger proportion of this total than in other areas. The argument in favour of this hypothesis is that "the effect of environment on mortality is at a maximum in the second year of life, and so it is just at this age that the country child should be relatively in the most favourable position for recovery from an attack of whooping-cough." * In support of the hypothesis that changing environment least affects the mortality in infancy may be cited the figures of Table IIA. It was shown there that the improvement in the death-rates over the last seventy years, though very considerable at all ages under 5, was

* "The Age Distribution of Whooping-cough, Measles, Chicken-pox, Scarlet Fever and Diphtheria in various areas in the United States," by W. Thurber Fales. *Amer. Journ. of Hygiene*, VIII, Sept. 1928, pp. 759-90.

least in infancy and most at ages over 2 years. An additional hypothesis is, however, required, "that recovery from attack is especially associated with the physical fitness in the case of whooping-cough"; this is necessary to explain the fact that the "same comparative rural immunity in the second year of life does not apply similarly to other infections of childhood." * Generally, without further knowledge of case incidence it seems impossible to reach a definite conclusion on this further problem of the epidemiology of the disease.

Summary and Conclusion.

1. The history of whooping-cough cannot be traced beyond the middle of the sixteenth century, and not until the eighteenth century do accounts of epidemics become numerous. The absence of earlier reference is curious but cannot be held to imply an absence of the disease.

2. In modern times a heavy fall has taken place in its mortality. In England and Wales the death-rate in 1921-30 was only one-third of that recorded in 1861-70. Throughout its known history very nearly all the deaths relate to children under five years of age. The mortality of older children has fallen more rapidly than that of infants.

3. Contrary to the general rule the mortality amongst females exceeds appreciably and constantly that amongst males.

4. There seems little doubt that females are more susceptible to clinical attack, especially after age two years is reached. Whether they succumb more easily to attack is doubtful, but, after the first year of life, the figures available suggest that they may do so.

5. This female excess is world-wide; it does not vary with urbanization; it shows no indication of variation in years of high or low mortality, but, on the other hand, seems to be lowest at the season of the year when the number of deaths (and probably the incidence) is at its maximum, and highest when the deaths reach their minimum.

6. Attempts to explain this phenomenon have been made in the past, *e.g.* in terms of the sex differences in the formation and development of the larynx, but none of the hypotheses so far put forward seems adequate.

7. Detailed examination of the mortality under one year of age shows various anomalies: (a) the female excess of mortality disappears, or nearly disappears, in the second three months of life; (b) illegitimate infants die in the first three months of life at a *lower* rate than the legitimate; (c) the mortality in the rural districts in the

* Registrar-General for England and Wales. Statistical Review for 1929. Text, p. 38.

first three months of life is higher than the corresponding mortality in the urban districts. No explanation of these apparent paradoxes is available.

8. Although in England and Wales the rural mortality is normally below the urban mortality, a larger *proportion* of the deaths takes place in infancy in the more sparsely populated areas. Again no satisfactory explanation can be put forward.

9. In 1921-30 whooping-cough was responsible in England and Wales for slightly more deaths than measles and for more deaths than scarlet fever and diphtheria put together. Its importance as a cause of death amongst young children is not, perhaps, always sufficiently recognized. In the Fourth Epidemiological Report of the Health Section of the League of Nations (1926) it is stated that "the opinion, often met with and reflected in the regulations for notification of these diseases, that whooping-cough and measles are less important than scarlet fever and diphtheria, evidently dates from the latter half of the nineteenth century, when the two latter diseases caused many more deaths than they do now, and when mortality under two years of age was so heavy as to leave less in evidence such causes as measles and whooping-cough." Its relative importance to-day would seem to call for further steps to combat it. Notification of cases, or a careful field study of the incidence of the disease, might contribute to this end by making clearer some of its present epidemiological obscurities.

DISCUSSION ON DR. HILL'S PAPER

DR. BUTLER: My first and most pleasant duty is to propose a vote of thanks to the reader of the paper, Dr. Bradford Hill. I am sure you will agree that we have listened to a most able paper on a most interesting subject: it is interesting because whooping-cough is one of those affections to which almost universally we are subject. I think that statement is true, although it has not been shown in respect of whooping-cough, as it has in measles, that it is practically a universal disease among the people of this country. Measles hardly anyone escapes, and although it is a disease of infancy, it is so because, owing to the high susceptibility and high risk of exposure, people contract it in infancy and so acquire an immunity which lasts throughout life. The contribution of whooping-cough to mortality is similar to that of measles; its mortality rate is probably somewhere about the same, and it may be inferred by analogy that it follows the same law of incidence, and that although it is a disease of infancy, it is so because immunity is acquired by attack early in life. That whooping-cough itself confers immunity has long been recognized, although it is not universal. I happen myself to be an example of

one who has suffered from it for a second time, and can remember both attacks. In an enquiry among persons exposed to whooping-cough, while 61 per cent. of persons of all ages stated previously not to have suffered, contracted it, 1.8 per cent. of those stated to have suffered previously suffered a second attack. That contrasts with similar figures for measles, where only 0.7 per cent. of those exposed to attack and having already suffered, contracted the disease. The figures for whooping-cough on which the percentages are based are smaller and more liable to error than those to which I have referred for measles, and it does seem to be brought out clearly by these figures, that when those who have suffered are exposed, they do not generally again contract the disease.

A most striking and the first phenomenon referred to in the paper is the extraordinary decline in the death-rate from whooping-cough and measles. Why that should be so is not quite evident, because these are diseases that have not been the subject of specific preventive measures in the way that scarlet fever, diphtheria and other notifiable diseases have been; it is not because of measures specially directed to that end that they have declined, because it is manifest right through from the 'sixties onwards. It is significant, however, that by far the greater part of that decline has occurred during the last three decennia, and during the last two decennia a new factor has been brought to bear upon these two diseases. They are not notifiable; they are not diagnosed in time to make notification of much value; but during these two decennia there has been instituted the medical inspection of school children which has brought to knowledge, earlier than notification would, the fact that children either attending the school or in houses from which they came were suffering from whooping-cough, and these had been the subject of special measures against the infection. That is probably the main specific factor bearing upon the more marked decline during the last two decennia.

The most striking fact of all that comes out in the paper is the difference in incidence both of attack and mortality in the sexes. The difference is a most marked and constant feature, and perhaps the most fascinating part of the paper is the analysis of the diverse conditions in which it has been observed. It is curious that females at all ages are more susceptible than males, but that females should be more susceptible to whooping-cough than males is no more remarkable than that males are more so than females to most other diseases. It is only because it is exceptional for the case to be reversed that it is so remarkable.

That there is a real sex difference comes out, definitely, from the paper, and that the susceptibility of the female to whooping-cough infection is greater than that of the male is in accord with the other sex differences which are demonstrated. There is another striking difference in the behaviour of whooping-cough and measles, which is this: I found in the course of my work on measles that only 10 per cent. of babies under six months of age contracted the disease when exposed to infection; whereas 77 per cent. of those similarly exposed of ages 6-12 months were attacked. Infants have a congenital

immunity to measles lasting for about six months. During the second six months of life they are much more susceptible, but this early immunity does not appear to obtain with whooping-cough. Children have been born with whooping-cough and developed it within ten days of their birth when the mothers have been suffering. If there is a six-months immunity in the infant in the case of measles, it is an immunity conferred by the mother, and the mother fails to confer a similar immunity from whooping-cough on her infants. That is a difference in behaviour to two contrasted diseases just as striking as others that come out in the paper.

The different behaviour of illegitimate and legitimate children to whooping-cough clearly cannot be due to anything intra-corporeal. It must be an environmental factor, because it is inconceivable that illegitimate children are in any way different in tissue and structure from the legitimate. There is, however, often a great deal of difference between these children in the way of exposure to infection. Infection is usually brought into the house by the children mixing in the schools or streets with others who are affected. The first-born children ought to run less risk of contracting the disease, and therefore of dying from it. Illegitimate children are first-born children for the most part; they have not the risk of exposure that other children in large families have, where the younger children get whooping-cough and die of it because they are exposed to a greater risk of its being imported during the early years of life by elder brothers and sisters. I feel that this is the explanation of a difference that cannot conceivably be accounted for upon anatomical or physiological grounds.

Reference has been made to the fact that both whooping-cough and measles have an apparent rate of incidence or mortality lower than the true rate, owing to the fact that many of these cases are missed. It almost invariably happens that when either of these diseases is epidemic, the rates of death from pulmonary disease are materially increased. That is because broncho-pneumonia and other pulmonary affections are complications of these diseases and are the killing factor. In the case of measles particularly, it is the broncho-pneumonia that the doctor is called in to treat, and the death appears as from broncho-pneumonia, and measles is not mentioned, because its sequela is all that is in evidence.

The period at which after onset death occurs has a material bearing on this point. I had the opportunity of finding out among a considerable number of deaths at what stage of the disease the children died, and I found that in whooping-cough those who died during the various stages were as follows :-

					Measles.	Whooping-cough.
Deaths during						
1st week	...	...	...	...	25.5	9.6
2nd "	...	...	...	...	45.4	25.4
3rd "	...	...	...	...	14.2	23.3
4th "	...	...	...	...	5.6	19.8
after 4th week	...	...	...	...	7	24.5

I do not believe that that represents the actual respective periods of deaths from whooping-cough or measles, but the measles rash has disappeared, and evidence has gone when the patients die, and the death is returned as due to pneumonia. Four or five weeks after onset it is a death from pneumonia or bronchitis, and not from measles because evidence of the initial cause has long disappeared. Whooping-cough, on the other hand, is a disease in which the evidence persists throughout the complications, and this difference in persistence of evidence causes a greater proportion of whooping-cough deaths to be returned as such, long after onset. On the contrary, in the earlier stages before the whoop develops, the cause of the pulmonary complication is not recognized, whereas in measles while the rash is in evidence the opposite is the case. I cannot help feeling that both in time and in racial distribution, whooping-cough has always been an extremely widespread disease. It is curious that so little mention of it should have been made until the end of the eighteenth century; the occurrence of the disease has been indicated too in Sydenham's "convulsive cough of children" although not definitely recognized, and this makes one believe that as it is now an almost universal disease, so it was then, although so little reference has been made to it.

SIR WILLIAM HAMER: It is a great pleasure to me to support the mover of this resolution, and we are all glad to welcome him back again. I am particularly pleased to be associated with him in supporting this vote of thanks to Dr. Bradford Hill, although he has anticipated me by saying certain things I was about to say myself.

There are, I understand, still some ultra-modernists who regard epidemiology as a "back number," lacking in up-to-date technique. We admit, of course, that it has come down, with geometry and much else, from the Greeks; moreover, as Professor Greenwood cheerily reminded America last year, the "conception of an epidemic succession was never so forcibly and even magnificently expressed" as by Sydenham, two hundred and fifty years ago. We all read Creighton, however, nowadays, and so there is gradually emerging the promise of a technique which may facilitate control of epidemic disease to such an extent as to safeguard civilization. Such a thought renders Dr. Hill's paper particularly instructive. He leads off with our old friends Creighton, Hirsch, Willis and Watt, and gives early warning of the danger of confounding whooping-cough with influenza; he then tackles, from a precise statistico-epidemiological point of view, a disease which almost all our fellows encountered in childhood—most of the men, however, in early infancy, some of the ladies before they were three months old, so that they have probably forgotten all about it, and Dr. Hill has thus quite a free hand.

The discussion of the "Female/Male ratio of Mortality" is most exciting. We are introduced to some very bold critics of Creighton's anatomical knowledge—Creighton, who, forsooth, was for several years demonstrator of anatomy at Cambridge—and then the same critics reject a "theory of sexual difference in sensitiveness of the

nervous system," basing their case upon there being two diseases of the nervous system more fatal in females than in males, while there are three more fatal in males than females; and this without even a passing allusion to the autonomic nervous system or to hysteria, hypochondria and the psychoses. These critics should read Sydenham's letter to Dr. Cole, in particular the sentence regarding "disorders arising from irregular motion of the animal spirits . . . destroying the function of the respective organs which they enter into, and of those also whence they came, both being highly injured by this unequal distribution, which prevents the economy of nature." This letter would convince them that two hundred and fifty years ago much was known about the questions they are discussing; moreover, strangely enough, these same critics, while admitting that laryngismus stridulus is more fatal in small boys, shy at the possibility that whooping-cough can, by reason of "sexual difference in sensitiveness," be more fatal in small girls. What would Gaskell and Langley and Eppinger and Hess have thought about such criticism!

Dr. Hill's own discussion of anomalies in whooping-cough mortality in the first three months of life is most illuminating; he cannot find any single explanation of the three paradoxes, but he gives us possible independent solutions. It would, indeed, seem likely that low mortality in girls (3-6 months) might well stand in some relation with their precedent high mortality at 0-3 months; perchance difficulty in demonstrating this arises from the disturbing influence of faulty diagnosis in the areas studied. The difficulty as regards medical aid, in less and more crowded areas in London, particularly interests me; it might perhaps be elucidated by study of development of hospital provision for whooping-cough in London during the last half-century. Mr. Spear's two Tables in the London Annual Report (1925) reveal the influence exerted by growing effort (1915-25) to secure treatment for poor children in hospitals; accommodation for such children (with measles or whooping-cough) doubled in those years, and the reduction in mortality surpassed all expectation.

The lower mortality in "illegitimates" is, once again, presumably partly due to faulty diagnosis. In fact, whooping-cough is very far from being what it has been the fashion to style a "clinical entity." Creighton (*Illustrations of Unconscious Memory in Disease*) has urged that "whooping-cough" is just "unconscious memory." He says we are told "one of the diagnostic marks between children's influenza and whooping-cough is that if the cough persists it is without whoop, but that (he adds) is a very palpable *ignoratio elenchi*." Dr. Stokes declares, "There is no absolutely pathognomonic sign of any disease whatsoever," and Netten Radcliffe said, "The materials with which Dr. Farr had to work . . . were defective enough to have discouraged a less sanguine and indefatigable statistician." Are present-day materials so very much less defective? Are we not now suffering from two simultaneous epidemic psychoses, the worship of the causal organism being conjoined with that of the pathognomonic sign? Will Epidemiology ever come into its own

again? A paper such as Dr. Hill's encourages us to think it will. I have great pleasure in seconding the vote of thanks.

DR. PERCY STOCKS congratulated Dr. Hill on his excellent paper. He had a fellow-feeling for Dr. Hill, because he had recently been into the wilderness of whooping-cough statistics himself, but whereas Dr. Hill dealt with registered deaths, he was dealing with notifications, so that his wanderings led him into morasses even more profound than those encountered by Dr. Hill. He had come back convinced that if statistical science could deal with whooping-cough, there was nothing with which it could not deal. He had had one advantage in that whilst studying this disease he suffered from an attack, and from that he learned two lessons, one being that children suffering from whooping-cough did not receive from their elders as much sympathy as they ought to do, and the other, that notification of whooping-cough in adults must always be very incomplete owing to dislike of admitting that one was suffering from a childish ailment. The latter consideration did not affect notification in children, however, and from his own researches, referred to by Dr. Hill, the conclusion had been reached that at all ages up to 10 in London, notification represented about 70 per cent. of the real incidence, and that about 60 per cent. of all children born in London suffered from an attack before they reached the end of school age.

Dr. Hill had rendered a most useful service in gathering together in this paper most of the available evidence in regard to the sex ratio, and subjecting it to critical examination. It was often by the study of these exceptions to a general rule that knowledge was advanced, and the exceptional nature of this ratio was well brought out in Table III. There seemed to be no doubt that in regard to mortality this held good even in the first two years of life.

In regard to incidence, Dr. Stocks found that in 15,000 cases notified in four London Boroughs, the sex ratio of females/males, taking males as 100, was:—

In the first two years of life	...	...	...	...	106
" next " "	...	...	...	...	103
Age 4	...	...	...	...	114

and it then rose steadily to 153 at ages 9–14, *i.e.* it began to rise at about 4, and increased more rapidly after age 8.

As to the cause of this female excess, Dr. Hill was not impressed with the larynx theory, and Dr. Stocks was rather inclined to agree.

In this connection Dr. Stocks was encouraged to make a very bold suggestion. Some eighteen years ago he was working in a panel practice in a mining town, in which there occurred an epidemic of whooping-cough, and in watching the children in working-class homes who were attacked by the disease, he noticed that at the warning of a bout of coughing in severe cases, the child would abandon what it was doing, and run to its mother or some other person near at hand. During a severe bout of coughing, the child is for the time being almost blinded and fighting for breath, and therefore needs help. In a working-class home this duty of attending to the child very often falls upon an elder sister, if there is one, and

quite a young girl of four or five years even may be seen holding the child, and in so doing receiving a heavy dose of infective material. This does not apply to any other infectious disease --the difference of the girl's duty over the boy's in this respect--and it occurred to Dr. Stocks that possibly there might be a greater risk to girls than to boys of receiving severe infection within the home on that account.

With regard to infection from children at school, or outside the school, there was also the question of difference in clothing. Girls wore pinafores or frocks which were frequently used to wipe the mouth, face, or eyes, and if infective material from some coughing child lodged upon these clothes, it did seem conceivable that a girl's clothes were more dangerous to the wearer than a boy's, although this might be thought to be rather a wild suggestion.

Not having been out in the Philippines, Dr. Stocks said he did not know what kind of clothing the children wore there, but he would imagine that the difference was not so great or of the same kind as it was in England. It was a curious fact that on looking at the official statistics for 1928, it appeared that deaths from whooping-cough in the Philippines numbered 1,066, with the following sex ratios of females to males :—

First year of life	...	...	...	...	...	...	97
Second „	...	...	...	...	...	...	94
At age 2-4	...	...	...	...	...	...	87
At age 5-9	...	...	...	...	...	...	82
At 10 years and over	...	...	...	...	...	...	71

i.e. an excess of male over female deaths, just as for other diseases. Was that due to difference in climate? It would rather suggest that clothing might have something to do with it.

Dr. Stocks admitted that though that might conceivably account for the rising sex ratio with age in European children, the excess under three months of age could not be accounted for in that way. Dr. Hill found that in the first year of life as a whole the excess was not so large—only about 7 per cent. for mortality, and the same was true for incidence.

The paper contained a good many other points of interest to which he would have liked to refer, but Dr. Stocks said he would content himself with one remark on the correlation between density of housing and proportion of deaths at under one year. Dr. Hill had shown that this correlation was negative. Last year the London County Council made a special enquiry as to what proportion of school entrants had suffered from whooping-cough up to the age of entry to school, and, dividing the London Boroughs into groups according to the different densities of housing, it was found that in Boroughs having less than .9 per room, the mean percentage of children who had had whooping-cough before the age of $3\frac{1}{2}$ was 41, and as the density was increased up to 1.2 per room and over, the percentage fell to 32. There seemed to be a decreasing incidence before the age of $3\frac{1}{2}$ as the density of housing increased. That seemed to agree with Dr. Hill's result for mortality.

Dr. Stocks expressed the hope that the paper would help to arouse a greater interest in this disease. The mortality alone did not

measure the great extent of physical suffering that the disease caused, which in his opinion was greater than all the other infectious diseases of children put together, excluding diphtheria. He had great pleasure in supporting the vote of thanks to Dr. Hill.

MR. VIVIAN said that the paper presented a very intriguing and provocative problem. An early Lord Chancellor had described the law of equity as a "roguish thing," and that term might fitly be applied to the disease of whooping-cough, which, as explained in the paper, exhibited a series of anomalies and paradoxes which were remarkable. The true and primitive sense of that much misunderstood and abused aphorism, "the exception proves the rule," was peculiarly applicable here; and if in the case of a disease presenting such a number of exceptional features some glimmer of the truth as to their causation was ultimately ascertainable, it might have an important bearing upon the more normal features of the incidence of other diseases. For example, in the case of whooping-cough an exceptional feature was the preponderance of female mortality; and any light upon this phenomenon might throw light upon the preponderance of male mortality in other diseases, which, as Col. Butler had pointed out, was in reality no less peculiar.

Mr. Vivian said he would like to draw attention to the fact that, although Dr. Bradford Hill was unable to point to any conclusions which he felt justified in accepting, he had assisted and paved the way for further research by collecting together and summing up the state of knowledge on the subject in a manner that could not fail to be of the greatest possible value. The literature on any particular medico-statistical subject was bound to be scattered, and was usually contained in casual periodical publications, both British and foreign, which were not always easily accessible; and this paper had done good service to the future study of this particular problem and afforded a valuable asset to future research workers, by having collated and put together the state of knowledge on the subject in such an able, thorough and well-balanced manner. That was a work that should be done in other branches of medico-statistical science. He hoped that the paper would encourage such work in other quarters.

DR. ISSERLIS joined in thanking Dr. Hill for his paper. He said he would like to ask a question with regard to a point not mentioned in the paper. As far as he could see, no reference had been made to the question of periodicity. Was there no apparent periodicity in whooping-cough at all? So much had been heard of the regularity of recurrence in the case of measles, and measles had been mentioned so often in the paper and in the discussion, that the question of periodicity of whooping-cough would seem to be relevant.

Dr. Butler in his remarks had referred to the change brought about in the last twenty years by medical inspection of schools. Was not the medical inspection of a school a rather rare and isolated phenomenon during the year? Dr. Isserlis did not quite follow how medical inspection could take the place of notification.

Some of the problems mentioned in the paper were sufficiently intriguing to create problems for statistical research for those even who knew nothing whatever of medicine.

DR. BUTLER said that it was not, of course, the actual medical inspection, but the system of medical inspection of school-children that had developed throughout the country, which embraced notification of illness by teachers and attendance officers, bringing to the knowledge of the school medical officer cases of ill-health, and an ensuing enquiry into the cause of absence from school. As a result of that system houses were visited and enquiries made, facts being brought to the knowledge of the medical officer by health visitors, inspectors and voluntary workers. This development of the preventive medicine service had brought about a knowledge of the extent and nature of diseases among children even greater than that derived from notification.

PROFESSOR GREENWOOD found Dr. Butler's remarks so instructive that he wished to ask him to expand them on one point. With regard to the certification of deaths, was his point that, supposing in a case of measles death occurred from a sequela long after the rash had disappeared, the measles was forgotten by the parent, but that in a long-drawn-out complaint like whooping-cough the sequel of death was more likely to occur during the continuance of the primary disease, so that the association was not so likely to be forgotten?

DR. BUTLER said the answer to Prof. Greenwood's question was in the affirmative. He had given the figures of the week of the disease in which deaths were alleged to be due to whooping-cough and those due to measles. It would be seen that in the case of whooping-cough up to five weeks except during the first, roughly about 20 per cent. of deaths occurred each week, whereas in the case of measles about 70 per cent. of the deaths occurred during the first fortnight. Since the causes of death in both whooping-cough and measles were the pulmonary complications that arose and occurred late in measles as in whooping-cough, causing death at a later period than two weeks, the assumption was that in measles the death was ascribed only to the complications, whereas in whooping-cough the death was ascribed to the primary cause owing to the continued evidence of the disease itself.

MR. DUDLEY WALTON asked if the term "whooping-cough" had always meant what it meant at the present day? When one examined vital statistics the lists of to-day were found to vary from those of forty years ago; was the disease of whooping-cough the same? Certain diseases did differ in their intensities and character.

PROFESSOR GREENWOOD said he would like to join with the previous speakers in congratulating Dr. Bradford Hill on his scholarly

and careful paper. This careful objective analysis was of very great value, and he agreed with the Registrar-General and others who had taken part in the discussion, that although Dr. Hill might feel a little disappointed at not being able to give a complete account of the paradox of sex differentiation of mortality, it was precisely by collating the evidence in this way that one would ultimately reach the explanation.

Dr. Hill had said that whooping-cough as a cause of mortality was not always sufficiently recognized. So far as members of the Public Health Service were concerned it was very well recognized, but so far as the general public were concerned, no doubt that was true. It might even happen that as a result of this paper some newspaper would feature the subject of whooping-cough and ask why the Ministry of Health or the Medical Research Council had not done something about it. It might be said that the statistical facts relating to whooping-cough had been plainly stated in the Annual Reports of the Registrar-General for a great many years, and he was inclined to think that the tendency was becoming rather accentuated for newspapers to "discover" facts which had been very well known to most statisticians and members of the Health Services for decades, and should have been very well known to those who assumed the responsibility of instructing the public on administrative or political topics, but seemed to be ignorant. This proclaiming in angry tones that "something should be done about it" was a growing evil. A picturesque example had recently been afforded by *The Times* in an article on "The Population Trap." Such statistical facts in that article as were correct had been very well known to all persons who read official reports for the last twenty-five years; nevertheless, the writer proclaimed that—

"It is not enough for a handful of population experts to calculate for specialized use such figures as they happen to need in the course of their researches,"

and he went on to demand the formation of *another* Public Department to make these facts known. Professor Greenwood liked to see a little romance in human life. The picture of the Registrar-General's staff computing results for the "specialized use" of one another, or of the staff of the Medical Research Council reading papers one to another, certainly recalled the romantic days of Corydon and the eclogues, but had no contact with reality. The vista of a series of Public Departments, the first term being a new staff to read the reports of the Registrar-General, the next term, a staff to read the reports of the staff who read the reports of the Registrar-General and so on, was again only a romantic dream. But *The Times* had at least demonstrated that the press were even more ignorant than we had supposed of the facts of vital statistics, so that it was very important to give publicity to the fundamental facts of vital and medical statistics, and that was not the least of the services rendered by Dr. Bradford Hill in this valuable paper.

Professor Greenwood put the motion to the meeting that the

hearty thanks of the Society be accorded to Dr. Bradford Hill for his excellent paper.

DR. BRADFORD HILL in reply expressed his gratitude to the meeting for the kindly way in which they had accepted what was in the main only a descriptive paper in which he had endeavoured to collect and collate the basic epidemiological data. Apart from a few minor comments he would prefer to postpone his reply until he had had opportunity to digest the many interesting points raised by speakers. Dr. Hill's written reply is as follows.

I agree with Dr. Butler that the different behaviour of illegitimate and legitimate children in the first three months of life is difficult to explain on any but environmental grounds, but if lack of domestic infection is the cause I cannot see why this should not apply equally to measles or why its effect should disappear so completely at 3-6 months of age. A possible explanation has been suggested to me by Dr. Helen Mackay. Discussing the difficulties of early diagnosis, to which both Dr. Butler and Sir William Hamer referred, she suggests that a young and feeble baby would be very unlikely to "whoop." If we presume that illegitimate babies are on the whole less robust than legitimate babies then more whooping-cough may pass undiagnosed amongst them. On the other hand, if faulty diagnosis is the explanation of the three anomalies that I have discussed at 0-3 months of age it must be assumed that it disappears at 3-6 months, for then the customary ratios are observed.

I must confess that I am unmoved by Sir William Hamer's plea that after all Creighton was for several years a demonstrator of anatomy in Cambridge. I cannot find that Creighton's explanation of the female/male ratio of mortality is based upon any demonstration of actual sex differences in the larynx at this early age, and at least equally competent anatomists seem to be agreed that until puberty is reached the size of the larynx does not materially differ between the two sexes. I still think that this is a plausible explanation but one that is not based upon adequate evidence.

Dr. Stock's suggestion of the greater risks run by the girl in attending to a younger sufferer is an interesting one, though it cannot account for the higher mortality and higher incidence rates in female children under two or three years of age. It might be a partial explanation of the rising ratio with age and statistics for different social classes might throw some light upon it. Boroughs such as Hampstead where one would expect that the duties of an elder sister would be less onerous, and that she would be better protected from risk, certainly show an excess mortality amongst females under 5 years of age, though at later ages the deaths are too few to allow interpretation (1901-10 Decennial Supplement).

I am equally ignorant of the Philippine costume and must add also of their registration methods. For the provinces of the islands I have taken from the official records the deaths from whooping-cough for the three years 1923, 1924 and 1925. They are as follows:—

Deaths from Whooping-Cough.

	Under 1 year of age		Years								Total.
			1-		2		5		10 and over.		
			M.	F.	M.	F.	M.	F.	M.	F.	
1923	236	195	112	127	159	152	4	—	—	—	985
1924	253	189	177	163	190	172	68	74	43	55	1384
1925	243	180	109	92	146	167	44	46	41	32	1100
Total	732	564	398	382	495	491	116	120	84	87	3469
F./M. ratio	77		96		99		103		104		

The final ratios bear no resemblance to those I have shown for England and Wales, but they also bear no resemblance to those Dr. Stocks found for the Philippines in 1928. He showed a continually falling female/male ratio with age compared with the continually rising ratio that I find for 1923-5, with a slight female excess at ages over 5. The absence of deaths at ages over 5 in 1923 and their appearance in quite considerable numbers in 1924 and 1925 does not inspire confidence in these statistics. In addition we are arguing from deaths only and I have been unable to obtain the exposed to risk. Registered births in the city of Manila (and they are admitted to be defective) suggest a very high M./F. ratio at birth—112 for 1915-19 and 108 for 1922-25. If these ratios are true they show a relatively higher male population exposed to risk in the early years than is found in this country, which would of course to some extent affect the death ratios. Possibly female births tend to be unregistered, but if that is the case so may their deaths, at any rate by cause. I feel that at present we lack sufficient data and sufficient knowledge of the vital statistical methods to be at all confident that the Filipinos succeed in breaking the rule of female excess mortality from this disease.

The problem of periodicity I omitted from the paper in an attempt to keep its length within reasonable bounds. I would refer Dr. Isserlis to the study made by Dr. Matthew Young (An Investigation into the Periodicity of Epidemics of Whooping-Cough from 1870-1910 by means of the Periodogram, *Proc. Roy. Soc. Med.*, 1920, XIII, pp. 207-234). He concluded that, while the periodicities of whooping-cough do not appear to be so notable or so well-defined as those of measles in the corresponding towns, there is conclusive evidence of a more or less regular periodicity in the majority of towns that he was considering, and that the cycles are too definite to be regarded as due to accident. On the other hand, variable periodicities were found in different localities; for instance, unlike what occurs in measles, well-defined periodicities were found to occur in whooping-cough in some great towns which were totally unrepresented in London.

Whether whooping-cough has changed in character I am unable

to tell Mr. Walton. We certainly have no evidence of periodic fluctuations in virulence as seem probable with scarlet fever. That deaths directly attributable to whooping-cough will be sometimes debited to the pulmonary complications which are the killing factors, is, as Dr. Butler pointed out, quite certain, but whether registration for this cause is appreciably more accurate than, say, forty years ago, I do not know.

I am happy to be able to assure Professor Greenwood that as a result of this paper the Press did not "discover" whooping-cough. I agree with him that most of the basic facts with regard to whooping-cough mortality have for many years been emphasized in the Registrar-General's reports, but I feel that possibly insufficient attention has been paid to those facts. From the epidemiological aspect we have a curious disease the study of which research and public health workers have tended to neglect; from the public health aspect we have a serious cause of child mortality from a disease which is, I believe, still regarded somewhat contemptuously by the general public.

As a result of the ballot taken during the meeting, the candidates named below were unanimously elected Fellows of the Society:—

Cyril Leonard Clement Halstead.
Dines Charan Sen.

WHOLESALE PRICES IN 1932.

By THE EDITOR OF "THE STATIST."

(The *Statist's* index-numbers in continuation of Mr. A. Sauerbeck's figures.)

THE following table sets out the complete series of the *Statist-Sauerbeck* all-commodity index-numbers of wholesale prices. The index-numbers embrace forty-five commodities, the base years being 1867-77, which in the aggregate is equivalent to the average for the twenty-five years 1853-77. The table below, based with few exceptions on the average of fifty-two weekly quotations for each commodity, records the annual averages from 1846, *i.e.* from the commencement of the calculations, together with Jevons's figures adjusted to Sauerbeck's standard for the years 1809, 1810 and 1818. The statistics were compiled until the end of 1912 by the late Mr. Augustus Sauerbeck and subsequently by the *Statist*. The annual average for 1932 is 80. This figure is 3·6 per cent. below the average of the preceding year, 68·1 per cent. below that of 1920, the year of highest prices recorded in this series, and 31·1 per cent. above that of 1896, the year of lowest prices. Though the fall of 3·6 per cent. recorded for 1932 marks the eighth consecutive year in which wholesale prices have declined, the extent of the fall is less than in the

THE STATIST'S *Annual Index-Numbers* (in continuation of
Sauerbeck's figures).
(1867-77 = 100).

Year.	Average No.	Year.	Average No.	Year.	Average No.	Year	Average No.	Year.	Average No.
1932	80	1914	85	1896	61	1878	87	1860	99
'31	83	'13	85	'95	62	'77	94	'59	94
'30	97	'12	85	'94	63	'76	95	'58	91
'29	115	'11	80	'93	68	'75	96	'57	105
'28	120	'10	78	'92	68	'74	102	'56	101
'27	122	1909	74	'91	72	'73	111	'55	101
'26	126	'08	73	'90	72	'72	109	'54	102
'25	136	'07	80	1889	72	'71	100	'53	95
'24	139	'06	77	'88	70	'70	96	'52	78
'23	129	'05	72	'87	68	1869	98	'51	75
'22	131	'04	70	'86	69	'68	99	'50	77
'21	155	'03	69	'85	72	'67	100	1849	74
'20	251	'02	69	'84	76	'66	102	'48	78
1919	206	'01	70	'83	82	'65	101	'47	95
'18	192	'00	75	'82	84	'64	105	'46	89
'17	175	1899	68	'81	85	'63	103	'18	159*
'16	136	'98	64	'80	88	'62	101	'10	171*
'15	108	'07	62	1879	83	'61	98	'00	189*

* Jevons' numbers adjusted.

previous three years, the fall in 1931 from the previous year being 14.4 per cent., in 1930, 15.7 per cent., and in 1929, 4.2 per cent.

The index-numbers of the groups and sections forming the all-commodity index are shown below. The foodstuffs group as a whole is down by 4.8 per cent. in 1932, as compared with 1931, while the materials group has fallen by only 1.2 per cent. This uneven decline has a little upset the equilibrium (by reference to the base years) reached by the two groups in 1931 but the divergence is inconsiderable by comparison with that which existed, for example, in 1927.

Summary of Index-Numbers. Groups of Articles, 1867-77 = 100.

	Vegetable Food (Corn, etc.).	Animal Food (Meat, etc.).	Sugar, Coffee, and Tea.	Total Food.	Minerals.	Textiles.	Sundry Materials.	Total Materials.	Grand Total.	Silver.*	Wheat Harvest.†	Average Price of Consols.‡	Average Bank of England Rate.‡
												£	Percent.
1873.....	106	109	106	107	141	103	106	114	111	97.4	80	92½	4.750
1896.....	53	73	59	62	63	54	63	60	61	50.5	112	110½	2.483
1908.....	70	89	48	72	89	62	73	74	73	40.1	108	86½	3.013
'09.....	71	89	50	73	86	64	76	75	74	38.9	113	83½	3.083
'10.....	65	96	54	74	89	73	81	81	78	40.5	102	81½	3.725
'11.....	70	90	61	75	93	76	81	83	80	40.4	110	79½	3.467
1912.....	78	96	62	81	110	76	82	88	85	46.1	97	76½	3.776
'13.....	69	99	54	77	111	84	83	91	85	45.3	105	73½	4.771
'14.....	75	100	58	81	99	81	87	88	85	41.6	109	72½	4.038
'15.....	108	126	70	170	126	92	109	108	108	38.9	106	65½	5.000
'16.....	133	152	86	130	158	129	136	140	136	50.4	97	58½	5.470
1917.....	177	192	113	169	172	192	174	179	175	65.8	102	54½	5.15
'18.....	168	207	130	174	192	222	202	206	192	76.4	111	56½	5.0
'19.....	179	213	147	185	220	228	219	222	206	85.3	98	54½	5.166
'20.....	227	263	198	234	295	262	244	264	251	76.1	96	47½	6.71
'21.....	143	218	83	158	181	140	145	153	155	48.1	118	47½	6.092
1922.....	107	184	82	130	142	134	124	132	131	51.6	105	56½	3.692
'23.....	98	162	101	122	155	140	117	134	129	49.4	105	57½	3.496
'24.....	119	158	105	130	158	170	120	146	139	50.7	107	56½	4.0
'25.....	118	162	89	128	154	165	119	143	136	52.5	114	56½	4.575
'26.....	108	150	88	119	154	133	114	131	126	47.1	99	54½	5.0
1927.....	108	138	83	114	141	131	118	129	122	42.8	109	54½	4.650
'28.....	107	142	78	114	123	136	117	124	120	44.0	109	55½	4.5
'29.....	99	146	72	110	126	122	111	119	115	40.2	114	54½	5.508
'30.....	77	142	54	96	112	84	97	97	97	29.0	99	56	3.4
'31.....	68	119	50	83	100	63	85	82	83	20.4	99	55½	3.975
'32.....	72	105	50	79	99	64	81	81	80	19.5	105	66½	3.017
Average 1904-13	68	91	53	73	95	74	76	81	77	44.1	106	82½	3.733
1890-99	61	80	63	68	71	56	66	64	66	55.8	103	103½	2.958
'78-87	79	95	76	84	73	71	81	76	79	82.1	97	99½	3.264
1818-27	109	90	151	111	128	105	106	112	111	98.0	—	—	3.692

* Silver (see note on p. 292), parity of 1 gold to 15½ silver = 100.

† Wheat harvest in U.K. to 1895: 29 bushels = 100; from 1896: 30 bushels = 100.

‡ Average price of Consols and the average Bank of England rate of discount are actual figures, not index-numbers; Consols 3% to 1888, 2½% from 1889, 2½% from April, 1903.

In the foodstuffs group there is a notable rise of 5·9 per cent. in the vegetable food section; this section, with that of textiles in the materials group, gives the only sectional rises in the index-numbers in 1932. As will be seen from the detailed statistics given at the end of this paper all the items in the vegetable foodstuffs group except rice, which remained stationary, and barley, which fell, shared in this rise. The animal foodstuffs section was again down and considerable declines were registered for mutton and pork and somewhat smaller falls for beef and bacon. In the remaining foodstuffs section, sugar and tea were both down but coffee was somewhat higher. In the materials group, the minerals section is down by 1 per cent.; there was a noticeable fall in copper prices, a considerable rise in the price of tin and though the domestic price of coal fell there was some increase in the average export price. The textiles section as a whole shows an increase of 1·6 per cent., very largely as a result of considerable rises in the price of flax and hemp. Mid-American cotton was down and, though Australian wool showed a small increase, Lincoln half hogs registered a considerable fall. In the sundry materials section, which is lower, there were notable falls in hides and leather.

THE STATIST'S *Annual Index-Numbers—ten-year averages*
(1867-77).

1818-1827 = 111	1896-1905 = 68	1910-1919 = 123
'28- '37 = 93	'97- '06 = 70	'11- '20 = 146
'38- '47 = 93	'98- '07 = 71	'12- '21 = 148
'48- '57 = 89	'99- '08 = 72	'13- '22 = 153
'58- '67 = 99	1900- '09 = 73	'14- '23 = 157
'68- '77 = 100	'01- '10 = 73	'15- '24 = 162
'78- '87 = 79	'02- '11 = 74	'16- '25 = 165
'88- '97 = 67	'03- '12 = 76	'17- '26 = 164
'90- '99 = 66	'04- '13 = 77	'18- '27 = 159
'91-1900 = 66	'05- '14 = 79	'19- '28 = 152
'92- '01 = 66	'06- '15 = 82	'20- '29 = 142
'93- '02 = 66	'07- '16 = 88	'21- '30 = 127
'94- '03 = 66	'08- '17 = 98	'22- '31 = 120
'95- '04 = 67	'09- '18 = 110	'23- '32 = 115

In analysing some of the influences on wholesale prices in the article corresponding to this last year it was suggested that major changes in the price level appeared to be the results of fundamental changes in the monetary factor, and that in 1931, when the pre-war level of prices had been regained, the international monetary system was again flung into the melting pot. Our justification for the latter statement was that while in September 1931 there were twenty-seven countries operating the gold or gold exchange standard, at the time of writing this number had been reduced to six. So far from having emerged in a new form, the international monetary

system has merely been thrown into further disorder by the paradoxical events of South Africa, the largest gold producer in the world, abandoning the gold standard in December 1932, and of the United States, with the largest gold stocks in the world, being compelled to suspend the convertibility of notes and place an embargo on the export of gold (March 1933).

During 1932 the importance of the monetary factor, which we have previously stressed, became more widely recognised. As the gold standard virtually ceased to function, two problems thrust themselves forward for solution. First, how to re-introduce a stable standard of international values to take the place of the old gold standard, and, secondly, how to prevent the admittedly disturbing economic effects of falling prices from continuing. A lead was given towards a solution of the latter problem by the British Government when a resolution was passed at the Imperial Economic Conference at Ottawa in August 1932 declaring in favour of raising and stabilising sterling prices and, if possible, gold prices also. This question has been placed upon the agenda of the World Economic Conference and it is clear from the comments on the agenda prepared by a committee of economic experts that the problem of raising prices to a level at which the ordinary economic stimulus of profits is revived will be linked up with that of restoring the international standard of values. One noticeable tendency during the year, as a result of the virtual breakdown of the gold standard, was the development of a kind of competition in currency depreciation in several countries with the object of securing some temporary advantage in the exports market. The inherent dangers which this sort of action holds are so patent that a considerable body of opinion has been driven to reconsider its attitude to the gold standard, which events had appeared somewhat to discredit, at least in its international aspect. The position of the British price level in 1932 must, of course, be considered in relation to the absence of the automatic control of the gold standard. It was thus possible for gold prices to decline sharply while sterling prices remained relatively stable, the adjustments being effected through the exchange value of sterling. It is even suggested that the freedom of sterling to move downward has contributed to the continued decline of gold prices and in so far as the exchange value of sterling has been influenced by the movement of short-term capital this may be the case, though it escapes statistical proof. However that may be, it is clear that the freedom of sterling to fluctuate has acted as a buffer to the influence of gold prices but while the relative stability in the British price level may be judged as satisfactory, the effect of sterling fluctuations on the currency arrangements of other countries must be regarded more doubtfully. The

stability of sterling prices is also remarkable in view of the fact that the tariff system proper came into force in March 1932 imposing duties ranging from 10-33½ per cent. According to a rough estimate the average rate of *ad valorem* duty thus imposed works out at about 14 per cent. for all imports.

THE STATIST'S *Index-Numbers—monthly averages by groups*
(1867-77 = 100).

	Vegetable Food.	Animal Food.	Sugar, Tea, and Coffee.	Food-stuffs.	Minerals.	Textiles.	Sundry Materials.	Materials.	All Commodities.
1930.									
Jan. ...	85.7	151.7	60.4	104.7	123.7	98.3	105.2	108.1	106.6
Feb. ...	79.3	156.0	57.5	102.9	120.7	96.5	104.0	106.2	104.8
March ...	77.3	148.5	56.9	99.2	118.8	94.4	105.5	105.7	103.0
April ...	78.7	149.5	57.2	100.3	112.2	94.2	102.4	102.5	101.5
May ...	76.4	138.5	56.3	95.1	111.1	94.6	100.4	101.5	98.8
June ...	75.0	139.2	53.0	94.0	109.1	88.3	95.8	97.1	95.8
July ...	78.4	135.2	49.8	93.3	110.0	82.5	94.9	95.2	94.4
Aug. ...	78.5	128.7	47.6	90.5	109.5	76.5	95.3	93.4	92.2
Sept. ...	75.3	132.4	48.3	90.7	107.4	73.0	93.6	91.0	90.8
Oct. ...	74.5	131.4	52.6	90.9	105.3	72.7	92.9	90.0	90.4
Nov. ...	72.3	127.4	51.6	88.2	105.9	70.2	91.6	88.9	88.6
Dec. ...	68.8	131.1	50.8	87.9	105.0	63.9	90.3	86.1	86.9
1931.									
Jan. ...	68.1	131.5	50.6	87.8	102.8	61.2	89.1	84.2	85.7
Feb. ...	69.0	124.3	48.6	85.1	104.6	62.8	90.4	85.7	85.5
March ...	69.9	126.1	46.5	85.7	102.8	64.0	89.8	85.4	85.5
April ...	69.9	127.1	48.7	86.5	100.1	63.2	86.0	82.8	84.4
May ...	67.8	123.0	49.1	84.2	96.0	59.8	86.1	80.7	82.2
June ...	70.8	119.9	49.6	84.2	99.7	61.3	84.6	81.5	82.6
July ...	66.4	118.9	46.5	81.6	96.4	59.1	83.0	79.2	80.2
Aug. ...	66.5	118.2	43.7	80.8	99.2	55.6	80.6	77.9	79.1
Sept. ...	68.0	115.1	50.8	81.8	99.9	61.0	81.1	79.9	80.7
Oct. ...	73.7	108.4	51.5	81.8	100.4	64.4	84.7	82.7	82.3
Nov. ...	76.0	105.1	53.6	82.0	102.4	66.0	84.9	83.8	83.0
Dec. ...	77.6	110.2	55.9	85.0	103.7	68.4	86.8	85.7	85.4
1932.									
Jan. ...	77.0	108.3	53.5	83.6	104.0	69.0	85.7	85.5	84.7
Feb. ...	83.3	111.1	52.1	87.0	102.6	67.8	90.1	86.7	86.7
March ...	81.7	108.2	50.9	85.0	96.8	65.8	87.6	83.4	84.1
April ...	84.2	108.0	51.2	86.0	96.6	62.4	81.9	78.7	82.5
May ...	80.4	110.0	50.7	85.0	94.5	57.5	77.9	76.7	80.2
June ...	68.2	104.8	48.8	77.6	94.2	58.2	78.9	76.6	77.0
July ...	69.9	107.9	48.7	79.4	96.6	60.3	80.4	78.6	78.9
Aug. ...	66.9	104.6	49.9	77.2	101.9	70.8	80.5	83.3	80.7
Sept. ...	67.8	103.3	50.3	77.2	103.4	66.5	81.2	82.7	80.4
Oct. ...	65.9	95.3	50.0	73.4	101.1	65.3	79.7	81.1	77.8
Nov. ...	64.8	96.2	48.9	73.0	102.2	64.5	80.6	81.4	77.9
Dec. ...	61.8	103.1	46.4	73.7	100.2	63.6	80.3	80.5	77.7
1933.									
Jan. ...	63.2	104.3	45.1	74.5	99.9	63.2	80.2	80.3	77.8
Feb. ...	59.9	105.1	47.5	74.0	99.4	60.8	79.7	79.2	77.0
March ...	57.5	108.7	49.3	74.6	99.9	61.9	77.5	78.8	77.0

World's Production of Silver (in millions of ounces).

	United States.	Mexico.	Canada.	Australia.	Other Countries.	Total.
1901... ..	55.2	57.6	5.2	10.2	44.8	173.0
'02... ..	55.5	60.2	4.3	8.0	34.8	162.8
'03... ..	54.3	70.5	3.1	9.7	30.1	167.7
'04... ..	57.7	60.8	3.7	14.5	27.5	164.2
'05... ..	56.1	65.0	5.9	15.0	30.3	172.3
'06... ..	56.5	55.2	8.5	14.2	30.6	165.0
'07... ..	56.5	61.0	12.8	19.0	34.8	184.2
'08... ..	52.4	73.6	22.1	17.2	37.8	203.1
'09... ..	54.7	73.9	27.5	16.3	39.7	212.1
'10... ..	57.1	71.4	32.9	21.5	38.8	221.7
'11... ..	60.4	79.0	32.7	16.6	37.5	226.2
'12... ..	63.8	74.6	31.6	18.1	36.2	224.3
'13... ..	66.8	70.7	31.5	3.5	51.4	223.9
'14... ..	72.4	27.5	28.4	3.6	36.5	168.4
'15... ..	74.9	39.5	28.4	4.1	37.3	184.2
'16... ..	74.4	38.2	25.4	4.2	26.6	168.8
'17... ..	71.7	35.0	22.2	10.0	35.3	174.2
'18... ..	67.8	62.5	21.2	10.0	35.9	197.4
'19... ..	56.7	62.7	15.7	7.4	32.0	174.5
'20... ..	55.5	66.8	12.6	7.5	33.0	175.4
'21... ..	53.1	64.5	13.1	4.9	35.7	171.3
'22... ..	56.2	81.1	18.6	11.3	46.3	213.5
'23... ..	73.3	90.9	17.8	10.3	50.2	242.5
'24... ..	65.3	91.5	19.7	10.8	52.2	239.5
'25... ..	66.1	92.9	20.2	11.1	54.8	245.1
'26... ..	62.7	98.3	22.4	11.2	59.0	253.6
'27... ..	60.4	104.6	22.7	9.0	57.3	254.0
'28... ..	58.4	108.5	21.9	9.0	59.5	257.3
'29... ..	61.2	108.7	23.1	9.0	59.7	261.7
'30... ..	51.0	105.0	26.0	8.9	57.1	248.0
'31... ..	31.0	86.0	21.0	7.6	47.4	193.0
'32*	23.0	72.0	18.0	6.5	40.5	160.0

* Provisional.

Index of Silver Prices.

The base of the index-numbers given below is 1 gold to 15½ silver = 100, which, when Great Britain was on the gold standard, gave a basic figure of 60·84*d.* per standard ounce.*

	Price per oz. standard.	Index- number.		Price per oz. standard.	Index- number.
	<i>d.</i>			<i>d.</i>	
Average 1873 ...	59½	97·4	<i>Lowest</i> Nov., 1902	21½	= 35·6
" '90-99...	34	55·8	End Dec., 1906 ...	32½	= 53·1
" 1917-26...	40½	= 66·6	" Dec., '08 ...	23½	= 38·1
" 1893 ...	35½	= 58·6	" Dec., '11 ...	25½	= 41·2
" '96 ...	30½	= 50·5	" Dec., '12 ...	29	= 47·7
" 1909 ...	23½	= 38·9	" Dec., '13 ...	26½	= 43·7
" '13 ...	27½	= 45·3	" June, '14 ...	26	= 42·7
" '14 ...	25½	41·6	" Dec., '14 ...	22½	= 37·3
" '15 ...	23½	= 38·9	" Dec., '15 ...	26½	= 43·1
" '16 ...	31½	= 50·4	" Dec., '16 ...	36½	= 58·7
" '17 ...	40½	= 65·8	" Dec., '17 ...	43½	= 70·0
" '18 ...	47½	= 76·4	" Dec., '18 ...	48½	= 77·9
" '19 ...	57	= 85·3	" Dec., '19 ...	77½	= 98·3
" '20 ...	61½	= 76·1	" Dec., '20 ...	40½	= 49·2
" '21 ...	36½	= 48·1	" Dec., '21 ...	34½	= 49·3
" '22 ...	34½	= 51·6	" Dec., '22 ...	31½	= 49·6
" '23 ...	31½	= 49·4	" Dec., '23 ...	33½	= 49·0
" '24 ...	34	= 50·7	" Dec., '24 ...	31½	= 50·4
" '25 ...	32½	= 52·5	" Dec., '25 ...	31½	= 52·1
" '26 ...	28½	= 47·1	" Dec., '26 ...	25	= 41·1
" '27 ...	26½	= 42·8	" Dec., '27 ...	26½	= 43·6
" '28 ...	26½	= 44·0	" Dec., '28 ...	26½	= 43·3
" '29 ...	24½	= 40·2	" Dec., '29 ...	21½	= 35·2
" '30 ...	17½	= 29·0	" Dec., '30 ...	14½	= 23·7
" '31 ...	14½	= 20·4	" Dec., '31 ...	20½	= 21·6
" '32 ...	17½	= 19·5	" Dec., '32 ...	16½	= 17·2

* All the index-numbers in the table from 1916 to 1925 inclusive and in 1931 and 1932 are calculated on the basis of the gold prices of silver instead of the sterling prices, though the latter are the quotations given in the table. In arriving at the index-numbers the price of gold during 1916, 1917 and 1918 is taken as 86*s.* 9½*d.* per fine oz., derived from the "pegged" New York rate of \$4·76½ to the £. For 1919 the average price of gold is taken as 93*s.* 4½*d.*, this being the parity price with the U.S. dollar, the average New York exchange in that year being \$4·429. The index-numbers for other dates are based on the quotations in the London market for exportable gold. The average price in 1920 was 112*s.* 11½*d.* per fine oz., in 1921 107*s.* 0½*d.*, in 1922 93*s.* 4*d.*, in 1923 90*s.* 3*d.*, in 1924 93*s.* 8½*d.*, and in 1925 85*s.* 5½*d.* At the end of 1919 the quotation was 109*s.* 8½*d.*, at the end of 1920 116*s.* 1*d.*, at the end of 1921 98*s.* 0*d.*, at the end of 1922 88*s.* 11*d.*, at the end of 1923 95*s.* 4*d.*, and at the end of 1924 88*s.* 2*d.* At the end of 1931 the price of gold was 121*s.* 11*d.*, and at the end of 1932 123*s.* 9*d.* The average price in 1931 was 92*s.* 6·23*d.*, and in 1932 118*s.* 0·82*d.*

Gold.—The following table shows the world's annual gold production since 1850. Prior to 1911 the estimates are those of the Bureau of the U.S. Mint and other authorities. The value is taken throughout at £4.25 per fine oz. The estimate for 1932 is subject to revision.

(000's omitted.)

Year.	Value of output. £	Year.	Value of output. £
1850	11,000	1892	30,134
'51	17,200	'93	32,363
'52	26,550	'94	37,229
'53	31,090	'95	40,843
'54	25,490	'96	41,559
'55	27,015	'97	48,509
'56	29,520	'98	58,949
'57	26,655	'99	63,027
'58	24,930	1900	52,312
'59	24,970	'01	53,630
'60	23,850	'02	60,975
'61	22,760	'03	67,337
'62	21,550	'04	71,380
'63	21,390	'05	78,143
'64	22,600	'06	82,707
'65	24,040	'07	84,857
'66	24,220	'08	90,995
'67	22,805	'09	93,302
'68	21,945	'10	93,544
'69	21,245	'11	94,930
'70	21,370	'12	95,783
'71	25,400	'13	97,481
'72	24,200	'14	92,709
'73	23,600	'15	97,114
'74	22,950	'16	92,597
'75	22,700	'17	87,236
'76	22,540	'18	78,605
'77	23,830	'19	73,078
'78	22,020	'20	68,522
'79	21,400	'21	67,848
'80	22,130	'22	66,723
'81	21,150	'23	77,888
'82	20,500	'24	81,807
'83	20,640	'25	82,267
'84	20,830	'26	82,211
'85	21,250	'27	82,582
'86	21,430	'28	83,961
'87	21,735	'29	82,862
'88	22,644	'30	88,500
'89	25,375	'31	94,300
'90	24,421	'32	101,500
'91	26,846		

The monthly (end of month) all-commodities index-numbers since 1887; together with quarterly averages for the group and final index-numbers since 1920 inclusive, are shown in the following pages.

Monthly Fluctuations of the Index-Numbers of 45 Commodities, 1867-77 = 100.*

	Jan.	Feb.	March.	April.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1888	70.9	70.6	69.9	69.8	68.1	67.4	69.0	70.1	71.0	72.4	72.7	73.2	70
1889	72.6	73.5	72.1	72.0	71.4	71.6	72.6	71.4	72.1	72.1	73.7	73.7	72
'90	73.2	72.7	71.5	71.2	70.8	70.5	71.2	72.8	72.2	72.9	71.2	71.1	72
'91	71.1	71.5	71.7	72.4	72.8	71.8	71.6	71.9	71.7	70.7	71.4	71.4	72
'92	70.0	70.0	69.1	68.9	68.8	67.7	67.8	67.4	66.8	67.4	68.2	67.7	68
'93	68.4	69.0	68.1	67.4	67.4	67.4	67.7	67.1	68.2	68.6	67.8	67.0	68
1894	65.8	65.0	64.3	63.8	63.1	63.1	62.6	63.0	62.7	61.7	60.8	60.1	63
'95	60.0	60.0	60.8	61.7	62.5	62.4	62.8	63.3	63.5	63.3	62.3	61.2	62
'96	61.4	61.4	60.7	60.3	60.1	59.3	59.2	59.7	61.2	62.6	62.6	62.0	61
'97	62.0	61.9	61.9	61.5	61.2	61.3	61.7	63.2	63.4	62.7	62.4	62.4	62
'98	62.8	63.4	63.0	65.5	66.4	64.7	64.3	64.0	63.9	63.6	63.9	63.8	64
1899	65.4	65.8	65.6	66.1	66.6	66.9	67.9	68.3	70.0	71.5	71.6	72.3	68
1900	74.0	75.1	75.7	75.6	75.5	75.7	76.2	76.0	75.5	74.7	73.9	73.4	75
'01	72.2	71.7	71.0	70.6	70.5	69.8	69.5	69.8	69.6	69.6	69.0	68.4	70
'02	68.8	68.9	69.2	69.7	70.9	70.4	70.0	69.5	69.3	68.8	68.6	69.1	69
'03	69.5	70.2	70.4	69.4	69.6	69.5	69.5	70.0	69.1	69.0	69.0	70.0	69
1904	70.4	70.8	70.8	70.5	69.9	69.4	69.9	70.4	70.7	71.0	71.2	70.9	70
'05	71.2	71.4	71.8	72.0	71.7	72.0	72.5	72.3	72.4	73.2	74.2	74.9	72
'06	75.2	75.0	75.7	76.5	77.0	76.9	76.4	76.7	77.5	78.5	78.6	79.7	77
'07	80.0	80.7	80.0	80.7	82.4	82.0	81.1	79.4	79.1	78.8	76.7	76.2	80
'08	76.0	74.5	74.1	73.8	73.6	72.9	73.1	72.2	72.5	72.2	72.2	72.3	73
1909	72.0	71.9	72.4	74.3	75.4	75.1	75.2	74.9	74.7	75.2	75.5	76.3	74
'10	77.1	78.1	79.1	78.5	78.2	76.9	78.1	78.2	77.6	77.2	77.8	77.9	78
'11	78.5	78.6	78.9	80.0	80.3	80.0	78.9	79.5	80.3	80.7	80.6	80.9	80
'12	81.8	82.9	84.4	85.0	85.3	85.5	86.5	85.9	86.7	85.8	85.3	86.4	85
'13	86.4	86.4	86.7	86.2	85.7	84.1	84.2	85.0	85.7	84.5	83.3	83.8	85
1914	83.5	83.8	82.8	82.3	82.3	81.2	82.4	87.9	89.3	89.8	88.8	91.6	85
'15	96.4	100.9	103.7	105.9	107.2	106.4	106.4	107.0	107.8	110.0	113.1	118.4	108
'16	123.6	127.0	130.4	124.2	135.4	131.0	130.5	134.5	134.4	141.5	150.8	154.3	136
'17	159.3	164.0	169.0	173.0	175.0	180.4	176.9	175.7	176.4	180.6	182.9	185.1	175
'18	186.2	187.3	188.0	189.8	191.1	192.3	192.9	195.9	197.1	197.8	195.3	196.0	192
1919	190.1	187.7	184.7	184.6	194.6	199.4	206.4	212.7	214.8	224.3	231.0	235.2	206
'20	245.3	260.4	261.8	266.1	260.0	255.7	254.6	253.5	248.7	239.9	223.8	207.2	251
'21	197.2	183.0	177.2	169.8	162.2	155.8	158.2	154.3	149.4	138.4	136.7	133.6	155
'22	132.5	132.2	133.3	134.8	135.5	135.6	134.0	129.6	127.9	130.1	130.6	129.1	131
'23	130.2	131.9	132.7	134.0	132.2	127.9	124.8	125.0	127.8	127.7	132.4	133.2	129
1924	137.2	138.8	137.0	136.8	136.4	136.3	138.4	138.0	141.6	146.1	145.5	147.7	139
'25	144.8	143.1	140.1	137.5	135.7	131.2	134.3	134.3	132.7	130.2	132.9	130.4	136
'26	129.3	127.9	126.1	125.5	125.7	124.9	126.0	127.0	128.0	131.0	130.8	123.0	126
'27	123.1	124.1	123.6	123.3	123.8	123.1	122.0	122.8	121.5	120.6	121.5	121.4	122
'28	120.9	121.1	123.6	125.6	126.2	122.6	120.3	118.0	116.8	116.8	117.9	117.9	120
1929	117.0	120.1	120.5	116.5	113.0	113.1	115.2	113.9	112.6	111.1	108.3	108.8	115
'30	106.6	104.8	103.0	101.5	98.8	95.8	94.4	92.2	90.8	90.4	88.6	86.9	97
'31	85.7	85.5	85.5	84.4	82.2	82.6	80.2	79.1	80.7	82.3	83.0	85.4	83
'32	84.7	86.7	84.1	82.5	80.2	77.0	78.9	80.7	80.4	77.8	77.9	77.7	80
'33	77.8	77.0	77.0										

* The average of the twelve monthly figures of each year does not necessarily coincide with the annual figures, as the latter are calculated mostly from the average of 52 weekly quotations, while the former are based on end-of-the-month prices.

Quarterly Movements of Prices.*

Summary of Index-Numbers, 1867-77 = 100.

Years.	Quar- ters.	Vege- table Food (Corn, etc.).	Animal Food (Meat, etc.).	Sugar, Coffee, and Tea.	Total Food	Min- erals.	Tex- tiles.	Sundry Mate- rials.	Total Mate- rials.	Grand Total.	Sil- ver.†
'21	I	151.4	270.6	100.1	184.5	222.6	153.5	187.9	186.7	185.8	46.8
	II	150.3	225.2	89.2	164.8	187.9	140.1	159.0	160.9	162.6	45.5
	III	149.8	202.5	81.4	155.3	174.3	142.7	147.6	153.4	154.0	48.0
	IV	118.3	166.9	78.3	127.8	149.6	150.0	132.3	142.4	136.2	52.4
'22	I	114.0	177.0	75.9	129.2	132.2	142.4	131.8	135.2	132.7	49.7
	II	116.0	199.5	80.3	139.2	134.7	136.0	128.3	132.4	135.3	52.0
	III	102.4	182.8	82.8	127.9	138.3	139.7	123.3	132.2	130.5	53.2
	IV	98.7	176.0	87.6	124.9	141.1	145.1	120.7	133.7	129.9	50.3
'23	I	94.0	175.3	100.6	125.3	154.4	139.4	122.2	136.2	131.6	50.1
	II	96.1	164.0	110.2	124.0	156.6	141.9	120.3	136.6	131.4	50.5
	III	100.3	157.7	96.2	120.6	149.0	134.8	113.9	129.7	125.9	48.2
	IV	101.1	152.0	105.1	120.7	158.9	153.5	115.0	138.7	131.1	48.8
'24	I	115.1	146.2	111.5	126.6	169.0	159.6	121.0	145.9	137.7	48.8
	II	118.3	155.3	97.2	127.5	156.7	165.2	118.4	143.1	136.5	49.9
	III	121.8	159.7	99.7	131.1	157.1	173.1	117.3	145.2	139.2	51.6
	IV	134.5	160.0	108.3	138.4	163.9	182.7	122.5	152.2	146.4	52.4
'25	I	129.0	165.6	98.8	136.1	157.0	171.6	123.9	147.5	142.7	51.6
	II	116.6	164.8	86.7	128.1	150.5	157.8	119.8	139.7	134.8	51.5
	III	112.6	163.3	83.5	125.2	153.9	159.2	117.3	140.1	133.8	53.3
	IV	108.9	155.1	82.6	120.4	153.7	159.8	114.5	139.0	131.2	53.1
'26	I	103.9	152.4	86.8	118.1	150.3	148.8	147.7	134.8	127.8	50.6
	II	104.1	155.0	88.4	119.5	148.0	135.7	113.7	129.7	125.4	49.3
	III	106.8	154.2	88.2	120.3	166.1	126.4	114.1	131.9	127.0	47.4
	IV	109.3	144.4	88.9	117.9	192.0	115.8	115.9	136.4	128.6	41.2
'27	I	108.1	143.4	85.4	116.1	155.0	120.7	118.3	128.9	123.6	43.0
	II	111.6	145.9	82.6	118.1	140.7	127.9	118.2	127.2	123.4	43.0
	III	106.9	138.1	80.8	112.9	133.3	139.8	118.1	128.8	122.1	42.1
	IV	104.5	132.1	82.0	110.0	132.8	138.6	120.6	129.5	121.2	43.3
'28	I	108.9	143.8	80.3	115.7	123.6	136.7	120.6	126.3	121.9	43.2
	II	118.0	152.0	81.1	122.8	122.9	140.6	117.9	126.3	124.8	44.7
	III	101.1	142.0	77.9	111.2	121.0	135.3	116.7	123.6	118.4	44.3
	IV	101.9	138.1	76.3	109.8	126.0	131.5	115.3	123.5	117.5	43.7
'29	I	102.9	142.7	75.4	111.8	130.2	130.7	116.6	124.6	119.2	42.8
	II	92.8	148.3	73.2	109.1	125.0	121.2	111.1	117.9	114.2	41.1
	III	99.9	143.4	71.7	110.0	126.9	115.6	111.1	116.7	113.9	39.6
	IV	91.3	145.2	64.2	105.4	122.9	107.9	108.7	112.3	109.4	37.3
'30	I	80.8	152.1	58.3	102.3	121.1	96.4	104.9	106.7	104.8	33.0
	II	76.7	142.4	56.5	96.5	110.8	92.4	99.5	100.4	98.7	29.8
	III	77.4	132.1	48.6	91.5	109.0	77.3	94.6	94.6	92.5	26.8
	IV	71.9	130.0	51.7	89.0	105.4	68.9	91.6	88.3	88.6	26.5
'31	I	69.0	127.3	48.6	86.2	103.4	62.7	89.8	85.1	85.6	21.8
	II	69.5	123.3	48.8	85.0	98.6	61.4	85.6	81.7	80.1	21.3
	III	70.0	117.4	47.0	81.4	98.5	58.6	81.6	79.0	83.0	21.9
	IV	75.7	107.9	53.7	82.9	102.2	66.9	85.4	84.1	83.6	21.5
'32	I	80.7	109.2	52.2	83.2	101.1	67.5	87.8	85.2	85.2	21.0
	II	77.6	107.6	50.2	82.9	95.1	59.4	79.6	77.3	79.9	19.4
	III	68.2	105.3	49.6	77.9	100.6	65.9	80.7	81.5	80.0	19.4
	IV	64.2	98.2	48.4	73.4	101.2	64.5	80.2	81.0	77.8	18.4

* The averages of the four quarterly figures to each year do not necessarily coincide with the annual averages, as the latter are based as far as possible on average weekly prices. See also the *Journal*, 1893, p. 221; 1895, p. 144; 1901, p. 90; and 1909, p. 70.

† Silver, parity of 1 gold to 15½ silver = 100.

Construction of the Tabular Statements.

The index-numbers here given are based on the average prices for the eleven years 1867-77. Take, for instance, the *Gazette* price of English wheat :—

	s.	d.	
Average, 1867-77 ...	54	6	= 100, average point.
„ 1914 ...	35	0	= 64, or 36 per cent. <i>below</i> the average point.
„ 1920 ...	80	7	= 148, „ 48 „ <i>above</i> „ „
„ 1926 ...	53	3	= 98, „ 2 „ <i>below</i> „ „

The individual index-numbers, therefore, represent simple percentages of the average point.

The articles are grouped in six categories :—

		1867-77. Total Numbers.	Example for 1932.	
			Total Numbers.	Average.
1. Vegetable food, corn, etc. (wheat flour, barley, oats, maize, potatoes, and rice) ...	8 Index-nos.	800	572	72
2. Animal food (beef, mutton, pork, bacon, and butter) ...	7 „	700	737	105
3. Sugar, coffee, and tea ...	4 „	400	200	50
1—3. <i>Food</i> ...	19 „	1,900	1,509	79
4. Minerals (iron, copper, tin, lead, and coal) ...	7 „	700	694	99
5. Textiles (cotton, flax, hemp, jute, wool, and silk) ...	8 „	800	513	64
6. Sundry materials (hides, leather, tallow, oils, soda, nitrate, in- digo, and timber) ...	11 „	1,100	893	81
4—6. <i>Materials</i> ...	26 „	2,600	2,100	81
<i>General Average</i> ...	45 „	4,500	3,609	80

The general average is drawn from all forty-five descriptions, which are treated as of equal value, and is the simple arithmetical mean as shown above.

Average Prices of Commodities.*

No. of Article }	0	1		3	4	5	6	7	8	1-8	10	
		Wheat.		Flour.	Barley.	Oats.	Malze.†	Pota- toes.‡	Rice.	Vege- table Food.	Beef.‡	
		English Gazette.	Ameri- can.	Town Made white(now "G.I.L.") s. per sack (280 lbs.).	English Gazette.	English Gazette.	Ameri- can Mixed.	Good English.	Rangoon Cargoes to Arrive.	Total.	Prime.	Mid- dling.
Year.	Silver.† d. per oz.	s. and d. per qr.	s. and d. per qr.	s. and d. per qr.	s. and d. per qr.	s. and d. per qr.	s. per qr.	s. per ton.	s. and d. per cwt.		d. per 8 lbs.	d. per 8 lbs.
1873 ...	59½	58-8	63	51	40-5	25-5	30	180	9-6	—	65	56
1912 ...	28½	34-9	38	32	30-8	21-6	27½	86	10-1	—	56	49
'13 ...	27½	31-9	36-5	30½	27-3	19-1	23½	78	8-2	—	54	49
'14 ...	25½	35-0	40-1	33½	27-2	21-0	29½	71½	9-1	—	56½	52½
'15 ...	23½	53-11	59-10	49	37-4	30-9	41½	93½	13-3	—	72½	67½
'16 ...	31½	58-5	67-7	52½	51-7	33-5	52½	153½	16-10	—	81½	76½
'17 ...	40½	75-9	83-3	58½	64-10	51-7	71½	186½	25-3	—	104½	101
'18 ...	47½	72-9	78-7	46½	59-0	49-3	78½	142½	26-2	—	103	103
'19 ...	57	72-10	74-10	46½	75-8	52-3	78½	198½	25-10	—	108	108
'20 ...	61½	80-7	92-4	66	90	57-4	90½	242½	41-10	—	125	125
'21 ...	36½	72-9	73-9	64½	54-4	34-5	38½	198	18-5	—	115	109½
'22 ...	34½	47-10	52-11	45½	40-1	29-1	31½	130	14-10	—	88½	82
'23 ...	31½	42-2	47-3	39½	33-8	26-8	36	101	14-10	—	79½	74½
'24 ...	34	49-3	53-9	43½	46-9	27-2	39½	186	16-9	—	82½	76½
'25 ...	32½	52-2	62-4	50½	42-0	27-2	38½	154	16-0	—	80	73½
'26 ...	28½	53-3	58-9	49½	36-11	25-1	29½	127	16-3	—	74	67
'27 ...	26½	49-3	58-3	44½	42-0	25-4	30½	136	15-11	—	70	62
'28 ...	26½	44-8	50-10	40½	39-0	29-0	38½	133	15-0	—	74	66½
'29 ...	24½	42-2	51-3	38½	35-5	24-7	36½	111	14-3	—	71	66
'30 ...	17½	34-3	36-10	33½	28-3	17-2	23	93	13-0	—	73	68
'31 ...	14½	24-0	25-1	22½	28-0	17-8	15½	146	9-8	—	67	61
'32 ...	17½	25-0	27-5	24½	27-1	19-3	18½	152	9-8	—	65	59
Average												
1904-13	28½	31½	36	30	25½	18½	24½	78	7½	—	51	44½
1890-99	34	28½	31½	27½	25½	17½	19½	72	6½	—	47	37½
'78-87	50	40	43½	34½	31½	21	25	102	8	—	55½	46
'67-77	58½	54½	56	46	39	26	32½	117	10	—	59	50

Index-Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.

	1873 ...	1912 ...	'13 ...	'14 ...	'15 ...	'16 ...	'17 ...	'18 ...	'19 ...	'20 ...	'21 ...	'22 ...	'23 ...	'24 ...	'25 ...	'26 ...	'27 ...	'28 ...	'29 ...	'30 ...	'31 ...	'32 ...
	97-4	108	113	104	104	98	92	137	95	851	110	112										
	46-1	64	68	70	79	83	85	74	101	624	95	98										
	45-3	58	65	66	70	73	73	67	82	554	92	98										
	41-6	64	72	73	70	81	90	61	91	602	96	105										
	38-9	99	107	106	96	118	128	80	132	866	122	136										
	50-4	107	121	114	132	128	163	131	168	1,064	138	154										
	65-8	139	149	127	166	199	221	160	262	1,413	177	202										
	76-4	134	140	102	151	190	241	122	262	1,342	174	207										
	85-3	134	134	102	194	201	242	170	258	1,435	183	216										
	76-1	148	165	143	231	221	279	207	418	1,812	212	250										
	48-1	133	132	140	139	132	118	169	184	1,147	195	220										
	51-6	88	95	100	103	112	96	111	148	853	150	164										
	49-4	77	84	86	86	103	111	86	148	781	134	149										
	50-7	90	96	95	120	105	122	159	167	954	139	152										
	52-5	96	111	109	108	105	119	132	160	940	136	147										
	47-1	98	105	107	95	96	92	109	163	865	125	134										
	42-8	90	104	98	108	97	95	116	159	867	119	124										
	44-0	82	91	87	100	112	118	114	150	854	125	133										
	40-2	77	91	84	91	95	112	95	143	788	120	132										
	29-0	63	66	72	72	66	71	79	130	619	124	136										
	20-4	44	45	50	71	68	48	125	93	544	114	122										
	19-5	46	49	53	69	74	58	130	93	572	110	118										

* The annual prices are the average monthly or weekly quotations, except potatoes, which are the average weekly quotations during the eight months January to April and September to December.

† Not included in the general average.

‡ Meat (9-13), by the carcase, in the London Central Meat Market.

§ La Plata from 1924.

Average Prices of Commodities—Contd.

No. of Article }	11 12 Mutton.		13 Pork.	14 Bacon.	15 Butter.	9-15 Animal Food. Total.	16A	16B Sugar.	17	18A*	18B*	18
	Prime.	Mid- dling.	Large and Small, average.	Water- ford.	Fries- land, Fine to Finest.		British West Indian Refining || s. per cwt.	Beet, German, 88 p. c., f.o.b. s. per cwt.	Java, Floating Cargoes. s. per cwt.	Ceylon Plan- ta- tion, Low Mid- dling.† s. per cwt.	Rio, Good. s. per cwt.	Mean of 18A and 18B.
Year.	d. per 8 lbs.	d. per 8 lbs.	d. per 8 lbs.	s. per cwt.	s. per cwt.							
1873 ...	71	63	54	81	123	—	22½	25	28	100	86	—
1912 ...	59	54	50	69	123	—	11	12½	13½	87	66	—
'13 ...	62	56	55	77	119	—	9½	9½	10½	81	53	—
'14 ...	64	57½	49	75½	120	—	11½	12½	13½	79	45	—
'15 ...	75½	69½	72	93½	141	—	14½	17½†	18½	78½	43½	—
'16 ...	93½	86½	87½	109½	191	—	24½	22½†	26½	77½	50	—
'17 ...	114½	109½	110½	148	216	—	31½	25½†	32½	94½	58	—
'18 ...	109½	109½	128½	183	247½	—	33	26½†	35½	128½	69	—
'19 ...	114	114	128	190½	252	—	38½	34½†	43½	145½	114½	—
'20 ...	144½	144½	168½	239½	301	—	58	65½†	74½	148	111½	—
'21 ...	130½	125½	121½	179	250	—	19½	18½†	22	120½	63	—
'22 ...	125	121½	101	145½	202½	—	15	14½†	15½	120½	74½	—
'23 ...	114½	107½	89	113½	186	—	25½	23½†	24½	117½	55	—
'24 ...	111½	103½	70	106	211	—	23½	20½†	21½	152½	85½	—
'25 ...	106½	98½	84½	128½	206½	—	16½	11½†	12½	153½	98½	—
'26 ...	89	80½	98½	130	173	—	16½	11½†	12½	154½	89½	—
'27 ...	86	79½	85	102½	178	—	16½	12½†	13½	143½	71½	—
'28 ...	92½	87	77	101½	185½	—	13½	10½†	11½	143½	81½	—
'29 ...	89½	83	91	116½	180½	—	11½	8½†	8½	141½	74½	—
'30 ...	92	86	89	105½	146½	—	8½	5½†	6½	106½	42½	—
'31 ...	79	73	65	83½	130	—	7½	5½†	5½	101½	33½	—
'32 ...	63	55	54	77	126½	—	7½	5½†	5½	105½	54½	—
Average												
1904-13	58½	51½	47½	67	113	—	10½	10½	12	75½	43½	—
1890-99	54½	41½	42½	59	100	—	11½	11½	13½	98	62	—
'78-87	64½	53	49	71	116	—	17	18	21½	78	52	—
'67-77	63	55	52	74	125	—	23	24	28½	87	64	—

Index-Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.

1873 ...	113	114	104	109	98	760	101	98	115	134	125
1912 ...	94	98	96	93	98	672	49	47	100	103	102
'13 ...	99	102	105	104	95	695	40	38	93	83	88
'14 ...	102	105	94	102	96	700	50	48	91	70	81
'15 ...	119	127	138	126	113	881	67	66	90	68	79
'16 ...	148	157	169	148	153	1,067	100	93	90	78	84
'17 ...	182	199	212	200	173	1,345	121	115	109	91	100
'18 ...	174	199	248	247	198	1,447	127	125	148	110	129
'19 ...	181	207	246	258	202	1,493	155	153	167	180	174
'20 ...	230	263	324	324	241	1,844	263	262	170	174	172
'21 ...	208	228	234	242	200	1,527	81	77	140	98	119
'22 ...	199	221	194	196	162	1,286	62	54	140	116	128
'23 ...	182	196	171	154	149	1,135	104	87	135	86	111
'24 ...	177	188	135	143	169	1,103	93	75	175	133	154
'25 ...	169	180	162	174	165	1,133	60	43	176	154	165
'26 ...	141	146	190	176	138	1,050	60	44	178	139	159
'27 ...	136	145	163	138	142	967	62	47	165	112	139
'28 ...	146	158	148	137	149	996	51	40	165	127	146
'29 ...	142	151	175	157	144	1,021	42	31	162	117	140
'30 ...	146	155	171	143	117	992	31	22	123	66	95
'31 ...	125	133	125	113	104	836	29	23	120	53	87
'32 ...	100	100	104	104	101	737	27	20	121	85	103

* Index-numbers not included in general average.

† East India good middling from 1908.

‡ Raw Centrifugals, 96 per cent. Pol., from 1924.

§ Comparative values.

|| White Javas, C.I.F., from 1924.

Average Prices of Commodities—Contd.

No. of Article.	19A*	19C*	19B*	19	16-19	1-19	20A	20B	21	22	—	23.
	Tea.			Mean of 19A and 19B.	Sugar, Coffee, and Tea. Total.	Food. Total.	Iron.			Copper.		Tin.
Year.	Congou, Com- mon.	Indian, Good Medium.	Average Import Price. d. and dec. per lb.				Scottish Pig. s. and d. per ton.	Clove- land (Mid- dle- brough) Pig. s. and d. per ton.	Bars, Com- mon. £ per ton.	Stand- ard. £ per ton.	English Tough Cake. £ per ton.	
1873 ...	12	—	16·67	—	—	—	117·3	—	12½	84	92	132
1912 ...	5½	8½	8·78	—	—	—	64·2	58·2	7¾	73	78	210
'13 ...	5	8½	9·06	—	—	—	65·6	58·3	7¾	68	73½	201
'14 ...	6	8½	9·19	—	—	—	57·1	51·0	7	59½	64½	161
'15 ...	8½	10½	11·01	—	—	—	71·2	65·2	10½	72½	82½	164
'16 ...	8	10½	11·29	—	—	—	90·0	84·0	13½	115½	134	182
'17 ...	16½	15½	14·68†	—	—	—	95·7	89·7	13½	124½	136½	238
'18 ...	20½	16	15·0	—	—	—	101·0	95·0	14	115½	126	331
'19 ...	13½	15	15·6	—	—	—	143·1	137·1	19½	92	99½	257
'20 ...	11½†	9½	14·97	—	—	—	214·11	208·11	28½	97½	112½	302
'21 ...	4½	7	12·4	—	—	—	168·6	137·4	19½	69½	72½	171
'22 ...	8½	13½	14·9	—	—	—	99·10	90·7	11½	63½	66½	162
'23 ...	11	17½	17·58	—	—	—	108·0	108·9	11½	65½	69½	206
'24 ...	9½	17½	19·0	—	—	—	96·8	88·2	12½	63½	67½	251
'25 ...	7½	14½	18·34	—	—	—	83·4	72·8	11½	61½	65½	267
'26 ...	7½	16½	18·82	—	—	—	87·2	87·6	11½	58½	63½	297½
'27 ...	6½	14½	18·68	—	—	—	80·5	73·0	11½	55½	60½	303½
'28 ...	6½	12½	16·84	—	—	—	69·9	65·9	9½	63½	66½	229½
'29 ...	6½	11½	16·11	—	—	—	74·0	70·3	9½	75½	78½	207½
'30 ...	5½	9½	15·12	—	—	—	76·0	67·0	9½	54½	58½	144½
'31 ...	4½	6½	13·29	—	—	—	71·0	58·6	10½	38½	39½	121½
'32 ...	4½	5½	10·75	—	—	—	68·2	58·6	10	31½	33½	140
Average	7½	7½	8½	—	—	—	57½	51½	6½	67½	72	164½
1904-13	4½	7½	9½	—	—	—	47	41½	5½	50	53	81
1890-99	6½	—	12½	—	—	—	46	38	5½	55	60	89
'78-87	11½	—	17½	—	—	—	69	60	8½	75	81	105
'67-77	—	—	—	—	—	—	—	—	—	—	—	—
Index-Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.												
1873 ...	107	—	97	102	426	2,037	170	—	152	112	—	126
1912 ...	48	—	51	50	248	1,544	95	—	89	97	—	200
'13 ...	44	—	52	48	214	1,463	96	—	94	91	—	191
'14 ...	53	—	53	53	232	1,534	84	—	85	79	—	144
'15 ...	74	—	64	69	281	2,028	106	—	128	97	—	156
'16 ...	71	—	65	68	345	2,476	135	—	166	154	—	173
'17 ...	160	—	85	117	453	3,211	144	—	166	166	—	227
'18 ...	186	—	87	137	518	3,307	162	—	170	154	—	315
'19 ...	120	—	90	105	587	3,515	217	—	234	123	—	245
'20 ...	100	—	88	94	791	4,447	329	—	343	130	—	288
'21 ...	39	—	72	55	332	3,006	237	—	232	92	—	163
'22 ...	77	—	86	82	326	2,465	148	—	136	84	—	154
'23 ...	98	—	102	100	402	2,318	168	—	144	88	—	196
'24 ...	82	—	110	96	418	2,475	143	—	152	84	—	239
'25 ...	70	—	106	88	356	2,429	121	—	144	82	—	254
'26 ...	69	—	109	89	352	2,267	135	—	139	77	—	283
'27 ...	60	—	108	84	332	2,166	119	—	136	74	—	289
'28 ...	56	—	98	77	314	2,164	105	—	120	85	—	219
'29 ...	54	—	93	74	287	2,096	112	—	118	101	—	198
'30 ...	46	—	88	67	215	1,826	111	—	121	73	—	138
'31 ...	42	—	78	60	199	1,579	100	—	123	52	—	115
'32 ...	38	—	62	50	200	1,509	98	—	121	43	—	131

* Index-numbers not included in the general average.

† Approximate.

‡ Nominal.

Average Prices of Commodities—Contd.

No. of Article } Year.	24 Lead.	25A Wallsend Hetton in London.†	25B New- castle Stream.	26 Average Export Price.	20-26 Mine- rals.	27 Milling Ameri- can. d.	28 Fair Dhol- lerah.¶	29A Petro- grad.¶	29B Russian Average Import Price.	30A Manilla Fair Roping.	30B Petro- grad Clean. (a)	31 Good Me- dium.††
	English Fig. £ per ton.	£ per ton.	£ per ton.	£ and dec. per ton.	Total.	d. per lb.	d. per lb.	£ per ton.	£ per ton.	£ per ton.	£ per ton.	£ per ton.
1873 ...	23½	32	—	20·90	—	9	6½	47½	44	43	36	18
1912 ...	18½	21½	14½	12·70	—	6·45	5½	36½	40½	26	37	21
'13 ...	19½	21½	15½	13·94	—	7·01	5½	34	41½	31½	38	26½
'14 ...	19½	21½	14½	13·65	—	6·41	4½	33	38	26½	43	27½
'15 ...	24	30½*	21½	16·96	—	5·87	4½	59½	66½	41½	60½	21½
'16 ...	32½	27½*	41½	24·64	—	9·00	7	76½	85½	54½	71	31
'17 ...	32½	27½*	30	27·16	—	16·55	13½	113½	151½†	84½	105½	30½
'18 ...	32½	33·6	33½	30·6	—	22·3	17½	120½	156½	99½	166½	30½
'19 ...	29½	45·3	45½	46·2	—	19·65	14½	120½	174½	58½	147½	50½
'20 ...	40	32	51½	79·8	—	23·14	13½	120½	345½	66½	145½	44½
'21 ...	24½	32½	29	34·83	—	9·4	5½	112½	118½	40½	145½	27½
'22 ...	25½	34½	24½	24·16	—	12·10	8	95	84½	33½	57½	30½
'23 ...	28½	32½	28	25·13	—	15·25	10	83½	84½	33½	57	26
'24 ...	35½	27½	22½	23·38	—	16·26	11·03	120	104½	44	81	31½
'25 ...	37½	29½	16½	20·08	—	12·64	11·01	92½	120½	46½	89½	49½
'26 ...	32½	**30½	**16½	18·59	—	9·40	7·75	65	72½	43	74½	43½
'27 ...	25½	23½	14½	17·80	—	9·54	8·27	95½	74½	43½	66½	32½
'28 ...	22½	21½	13½	15·67	—	10·92	8·66	98½	91½	37½	63½	33½
'29 ...	24½	23½	15½	16·13	—	10·26	7·73	76½	71½	37½	61	32
'30 ...	19½	24½	14½	16·64	—	7·49	5·12	53½	60½	26½	48½	20
'31 ...	14½	24½	13½	15·98	—	5·90	4·60	36	35½	18½	27½	15½
'32 ...	13½	23½	13½	16·27	—	5·24	4·85	45½	42½	18½	36	16½
Average												
1904-13	15½	18½	11½	11½	—	6½	5	32½	36½	30½	31½	18½
1890-99	12	17½	10½	10½	—	4½	3	27½	27½	25	12½	12½
'78-87	14	16½	8½	9	—	6	4½	33	34	35½	26½	15
'67-77	20½	22	12½	12½	—	9	6½	46	48	43	35	19

Index-Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.

1873 ...	117	145	—	167	989	100	92	97	101	95
1912 ...	89	99	—	102	771	72	79	82	81	111
'13 ...	93	98	—	112	775	78	84	80	89	140
'14 ...	95	97	—	109	693	71	67	76	89	143
'15 ...	117	140	—	136	880	65	64	134	130	111
'16 ...	159	125	—	197	1,109	100	104	172	161	163
'17 ...	158	125	—	217	1,203	183	201	282	243	207
'18 ...	158	153	—	245	1,347	248	253	294	341	207
'19 ...	143	206	—	370	1,538	218	219	313	264	264
'20 ...	195	145	—	638	2,068	257	203	495	270	236
'21 ...	118	147	—	279	1,268	104	86	246	237	145
'22 ...	123	156	—	193	994	134	118	191	116	162
'23 ...	139	147	—	201	1,083	169	148	179	116	137
'24 ...	175	125	—	187	1,105	181	163	239	160	167
'25 ...	183	135	—	161	1,080	140	163	227	174	261
'26 ...	157	138	—	149	1,078	104	115	147	151	231
'27 ...	125	105	—	142	990	106	123	181	141	172
'28 ...	109	97	—	125	860	121	128	203	130	178
'29 ...	117	106	—	129	881	114	114	157	126	168
'30 ...	95	113	—	133	784	83	76	121	96	105
'31 ...	71	112	—	127	700	66	68	76	58	84
'32 ...	65	106	—	130	694	58	72	93	70	85

* Approximate prices.

† Approximate.

‡ Nominal.

§ Best Yorkshire house after 1916.

¶ Now No. 1 Oomra, Fine.

|| Livonian Z.K. from 1921.

** Average price January-April, 1926.

†† Lightnings in 1931.

(a) Russian Siretz Group 1, Sort 1 from 1931.

Average Prices of Commodities—Contd.

No. of Article	32A	32B	33	34	27-34	35A	35B	35C	36A	36B	37
	Wool.			Silk.	Textiles. Total.	Hides.			Leather.		Tallow.
Year.	Merino, Port Phillip, Average Fleece.	Merino, Adelaide, Average Greasy.	English, Lincoln Half Hogs.	Twistee, †		River Plate, Dry.	River Plate, Salted.	Average Import Price.	Dressing Hides.	Average Import Price.	Town.
	d. per lb.	d. per lb.	d. per lb.	s. per lb.		d. per lb.	d. per lb.	d. and der. per lb.	d. per lb.	d. per lb.	s. per cwt.
1873 ...	25	11½	24½	21½	—	11	8½	—	18½	—	44
1912 ...	17½	9½	10½	10½	—	10½	8½	7-51	17½	17½	33
'13 ...	18	9½	12½	11	—	12½	9½	8-62	19½	19½	34½
'14 ...	18½	9½	12½	10½	—	13½	9½	9-11	21½	19½	31½
'15 ...	21½	10½	17½	9½	—	13	11	10-04	28½	21½	36½
'16 ...	32½	16½	20	14½	—	14½	13½	11-70	28½	27	46½
'17 ...	46½	23½	20½	21½	—	20	16	15-52	35	34½	62½
'18 ...	47½	23½	18½	25½	—	20½	13½	15-9	32½	32½	81½
'19 ...	67	32½	22½	26	—	22½	19½	17-1	36½	40½	87½
'20 ...	79½	32	22	38½	—	20½	18½	20-1	43½	71½	75
'21 ...	31½	11½	8½	26 9/16	—	9 1/16	8½	9-58	25½	46½	36½
'22 ...	39	17½	9½	28½	—	9½	8½	8-06	24½	36	34½
'23 ...	43 1/11	20	12	24½	—	9 1/2	8 1/16	8-23	23 7/11	31 7/11	36½
'24 ...	53 7/11	25½	18½	23 7/11	—	10 5/11	8½	8-63	22 7/11	33½	42½
'25 ...	41 1/11	17½	17½	18½	—	11 7/11	8 1/11	9-87	23	33	42½
'26 ...	36½	16 7/11	15	15 1/11	—	10 1/11	8	9-32	21½	35 1/11	38½
'27 ...	38 1/11	17 7/11	15 1/11	15 7/11	—	12 5/11	10 7/11	9-85	22 5/11	36 1/11	33½
'28 ...	37	17 1/11	17 1/11	14	—	15 1/11	11 1/11	12-09	23 1/11	37 1/11	36½
'29 ...	35½	13 3/11	16 7/11	13½	—	10 7/11	8 1/11	10-80	19½	38½	36½
'30 ...	18 9/11	8 1/11	10½	10½	—	6 1/11	6½	7-80	18½	33½	28½
'31 ...	14-7	7-1	8½	8 1/11	—	5½	5 9/11	6-12	17½	32½	19½
'32 ...	15-0	7-2	5 1/2	8 1/2	—	4 9/11	4½	5-47	17 3/11	28½	21 1/11
Average											
1904-13	17½	9	10½	11½	—	9½	7½	6½	16	17	31½
1890-99	13½	6½	10	11½	—	6½	5½	5	13½	13½	25
'78-87	18½	8½	11½	15	—	8½	6½	6½	15	17	35½
'67-77	21½	9½	19½	23	—	9	7	6½	16	18½	45

Index-Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.

	118	—	124	95	822	120	—	—	114	—	97
1873 ...	118	—	124	95	822	120	—	—	114	—	97
1912 ...	86		53	46	610	114			101		73
'13 ...	88		63	48	670	133			112		76
'14 ...	90		64	47	647	139			118		70
'15 ...	104		88	43	739	149			145		81
'16 ...	159		101	71	1,031	174			160		104
'17 ...	219		106	94	1,535	225			200		139
'18 ...	222		95	112	1,772	218			188		182
'19 ...	315		114	113	1,820	258			222		195
'20 ...	359		111	168	2,099	257			330		167
'21 ...	140		44	115	1,117	123			205		81
'22 ...	180		49	125	1,075	114			174		77
'23 ...	206		61	105	1,121	113			158		81
'24 ...	254		96	102	1,362	119			163		94
'25 ...	188		87	79	1,319	132			161		94
'26 ...	170		76	69	1,063	121			164		85
'27 ...	177		78	67	1,045	142			172		75
'28 ...	174		91	61	1,086	172			176		82
'29 ...	156		81	60	976	129			166		81
'30 ...	86		54	48	669	92			150		64
'31 ...	70		43	39	504	77			146		43
'32 ...	71		29	35	513	66			132		47

* Port Phillip fleece washed nominal since 1895, exactly in proportion with the value of clean wool.

† Common New Style from 1921.

Average Prices of Commodities—Contd.

No. of Article	38			40A	40B	41	42	43	44	45A	45B	55-45	20-45	1-45
	Oil.			Seeds.	Petro- leum.*	Soda.	Nitrates of Soda.	Indigo.	Timber.		Sundry Materials.	Total.	Total.	Grand Total.
	Palm.	Olive.	Lin- seed.	Lin- seed.	Re- fined.	Crystals.			Bengal, Good Consuming.	Hewn, Average Import Price.	Sawn or Split, Average Import Price.			
Year.	£ per ton.	£ per ton.	£ per ton.	s. per qr.	d. per gall.	s. per ton.	s. per cwt.	s. per lb.	s. per load.	s. per load.	Total.	Total.	Total.	Total.
1873 ...	38	43	32	62	15½	100	15½	6½	65	62	—	—	—	—
1912 ...	33	48	35½	60	8½	53	11½	2½	41	60	—	—	—	—
'13 ...	35½	49½	24½	45½	8½	47½	11½	2½	40	63	—	—	—	—
'14 ...	37½	50½	24½	48½	7½	47½	10½	5½	41½	64½	—	—	—	—
'15 ...	34½	51½	30	57½	8½	48½	12½	13½	58½	94½	—	—	—	—
'16 ...	44½	59½	41½	80½	12	78½	17½	13½	82½	148½	—	—	—	—
'17 ...	46	115½	56½	112½	16½	89½	25	10½	97½	210	—	—	—	—
'18 ...	44½	198½	63½	131½	21½	82½	27½	9	107½	271	—	—	—	—
'19 ...	69½	200½	92½	139½	17½	118½	24½	9½	137½	232½	—	—	—	—
'20 ...	69½	200½	88½	157	25½	150½	24½	14½	119½	261½	—	—	—	—
'21 ...	361½	80½	31½	72½	22½	140	18½	11½	68½	156½	—	—	—	—
'22 ...	34½	75½	39	75½	15½	123	14½	9½	46½	117½	—	—	—	—
'23 ...	36½	66½	42½	77½	13	103	13½	7½	48	131½	—	—	—	—
'24 ...	40½	79½	42½	81½	13½	101½	13½	6½	49½	122	—	—	—	—
'25 ...	40½	73½	43½	80½	13½	100	13½	5½	47½	122½	—	—	—	—
'26 ...	37½	79½	32½	63½	13	100	12½	5½	48½	107	—	—	—	—
'27 ...	34½	102½	31½	64½	13	100	12½	5½	45½	107½	—	—	—	—
'28 ...	35½	80½	29½	66½	11½	100	10½	5½	45½	111½	—	—	—	—
'29 ...	34½	72	35½	74½	12½	100	10½	5½	44½	107½	—	—	—	—
'30 ...	25½	52½	36½	61½	12½	100	9½	5½	44½	102½	—	—	—	—
'31 ...	19½	53½	18½	38½	11½	100	9½	5½	37½	83½	—	—	—	—
'32 ...	17½	57½	17	38½	10½	100	8½	5½	35½	75½	—	—	—	—
Average	31½	43½	26½	49½	6½	60	10½	3	38	56	—	—	—	—
1904-13	24½	35	19½	38	5½	53	8½	4½	40	45	—	—	—	—
1890-99	32½	40	23	46	6½	62	12½	6	47	47	—	—	—	—
'78-87	39	50	30	60	12½*	92	14	7½	60	54	—	—	—	—
'67-77	39	50	30	60	12½*	92	14	7½	60	54	—	—	—	—
Index-Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.														
1873 ...	97	86	105	122	109	110	92	111	1,163	2,974	5,011			
1912 ...	85	96	106	66	58	80	38	89	906	2,287	3,831			
'13 ...	90	99	78	68	52	82	38	90	918	2,363	3,826			
'14 ...	84	101	82	61	52	78	80	93	958	2,298	3,832			
'15 ...	89	104	97	71	53	90	184	134	1,197	2,816	4,844			
'16 ...	114	119	135	96	86	128	183	202	1,501	3,641	6,117			
'17 ...	118	231	187	129	98	178	142	270	1,917	4,655	7,866			
'18 ...	115	396	216	170	90	194	124	332	2,225	5,344	8,651			
'19 ...	178	400	258	138	128	177	126	325	2,405	5,763	9,278			
'20 ...	179	400	272	203	164	177	200	335	2,684	6,851	11,298			
'21 ...	95	160	116	177	152	135	158	198	1,600	3,985	6,991			
'22 ...	89	151	127	122	134	102	128	143	1,361	3,430	5,895			
'23 ...	93	133	134	104	112	96	103	157	1,284	3,488	5,806			
'24 ...	103	160	138	105	111	97	84	151	1,325	3,792	6,267			
'25 ...	104	147	137	105	109	96	79	150	1,314	3,713	6,142			
'26 ...	96	159	106	104	109	95	78	137	1,254	3,395	5,662			
'27 ...	88	205	107	104	109	90	76	134	1,302	3,337	5,503			
'28 ...	92	161	108	94	109	78	76	138	1,286	3,232	5,396			
'29 ...	89	144	122	102	109	73	76	134	1,225	3,082	5,178			
'30 ...	65	104	110	102	109	70	76	129	1,071	2,524	4,350			
'31 ...	51	108	63	90	109	65	76	106	934	2,138	3,717			
'32 ...	45	114	61	84	109	62	76	97	893	2,100	3,609			

* Petroleum average, 1913-77.

† Nominal.

MISCELLANEA.

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APPLICATION OF THE METHOD OF MAXIMUM LIKELIHOOD TO THE IMPROVEMENT OF CURVES FITTED BY THE METHOD OF MOMENTS.

By R. S. KOSHAL, M.Sc.

(Statistical Department, Rothamsted Experimental Station,
Harpenden).*Introduction.*

THE method of moments was regarded as efficient in fitting Pearsonian Curves, prior to 1921, when it was shown (1) by Fisher, that its efficiency is restricted to a small region for which β_2 lies between the limits 2.65 and 3.42; and for which β_1 does not exceed 0.1. Later (3) the same writer pointed out that the goodness of fit test will not be accurate if the method of fitting employed is inadequate; that is, if the statistics used in the estimation of parameters are inconsistent or inefficient. A statistic satisfying the criterion of efficiency can be found by the method of maximum likelihood as shown by Fisher in his paper, "The Mathematical Foundations of Theoretical Statistics" (1). This method may briefly be stated as follows :---

If in a frequency distribution obtained from a sample taken at random from a population specified by a parameter θ (or set of parameters), n_s represents the observed frequency in the class s and p_s is the probability of its occurrence in the same class (p_s being a function of the parameter θ), then an efficient estimate of the parameter θ can be obtained by maximizing the quantity

$$L = S(n_s \log p_s)$$

for variations of θ .

On account of mathematical difficulties it is not always possible to obtain an algebraic solution of maximum likelihood equations. In these circumstances it was later (4) shown by Fisher, that starting from an inefficient statistic it is possible to obtain by a single process of approximation an efficient statistic. This approximate method

of obtaining an efficient statistic from an inefficient statistic is used in the following pages to improve the statistics obtained by the method of moments. The method will be illustrated by its application to a coarsely-grouped frequency distribution belonging to Pearson's Type I.

Although the general theory, and the principle of its practical application, has thus been available for many years, the teaching of the improved methods, and even of the very evident need for improvement, has lagged behind, principally, perhaps, for lack of simple published examples, exhibiting the practical handling of the improved method. The example chosen is one in which the method of moments is not especially inefficient, though its failure on the question of goodness of fit is sufficiently evident; its chief interest lies in the treatment of the two practical difficulties caused by (a) grouped data, and (b) the use of a type of curves in which the equations of maximum likelihood involve integrals of a troublesome form. It is shown that neither type of difficulty need stand in the way of obtaining an efficiently fitted curve.

The Method of Approximate Solution.

Let us consider the simple case in which p , is a function of two parameters θ_1 and θ_2 . Let T_1 and T_2 indicate the moment solution, and T_1' , T_2' represent the efficient statistics obtained by the method of maximum likelihood to a first approximation. The corrections $T_1' - T_1$ and $T_2' - T_2$ can be calculated from the symmetrical equations:

$$\left. \begin{aligned} (T_1' - T_1) \frac{\partial^2 L}{\partial \theta_1^2} + (T_2' - T_2) \frac{\partial^2 L}{\partial \theta_1 \partial \theta_2} &= -A_1 \\ (T_1' - T_1) \frac{\partial^2 L}{\partial \theta_1 \partial \theta_2} + (T_2' - T_2) \frac{\partial^2 L}{\partial \theta_2^2} &= -A_2 \end{aligned} \right\}$$

The values A_1 and A_2 are the discrepancies from zero of $\frac{\partial L}{\partial \theta_1}$ and $\frac{\partial L}{\partial \theta_2}$ when T_1 , T_2 are substituted for θ_1 and θ_2 . It may also be noted that in the evaluation of the differential coefficients in the left-hand side of the equations, T_1 and T_2 are substituted for θ_1 and θ_2 .

In certain cases, however, it is not possible or convenient to calculate the values of $\frac{\partial L}{\partial \theta_1}$, $\frac{\partial L}{\partial \theta_2}$, $\frac{\partial^2 L}{\partial \theta_1^2}$, $\frac{\partial^2 L}{\partial \theta_2^2}$ and $\frac{\partial^2 L}{\partial \theta_1 \partial \theta_2}$ numerically; whereas L can be calculated directly from the equation:

$$L = S(n, \log p).$$

It will be shown that an adequate set of such values of L may be used to complete the necessary approximation.

In this method, first the value of L is calculated by using the values of p , obtained from the moment estimate of θ_1 and θ_2 . Let us write this value of L as L_{00} . Then θ_2 is kept constant and θ_1 is varied by giving it suitable small and equal increments, and from the two sets of values of p , thus obtained, two new values of L are calculated which are on either side of the value of L for the maximum likelihood solution. Let these values be designated L_{10} and L_{20} ; where L_{10} indicates that θ_1 is given one small increment, while L_{20} shows that two small increments are given to θ_1 and that in both the cases θ_2 is not changed. Similarly by keeping θ_1 constant and giving small increments to θ_2 , two values of L indicated by L_{01} and L_{02} are obtained. Finally, L_{11} is calculated from the values of p , obtained by giving one increment each, simultaneously to θ_1 and θ_2 .

If the true maximum of L is found by giving corrections x and y to our first estimates, x and y being measured in terms of our chosen increments as units, then the value of the likelihood obtained from any trial values using ξ and η increments respectively must be a maximum when $\xi = x$ and $\eta = y$. We may consequently express the value of L in terms of ξ and η in the neighbourhood of the maximum by the approximate quadratic expression :

$$L = c - a(x - \xi)^2 - 2h(x - \xi)(y - \eta) - b(y - \eta)^2 \quad . \quad (i)$$

where ξ and η take the values 0, 1, 2 in the trial cases evaluated.

For the moment solution, L_{00} , $\xi = 0$ and $\eta = 0$, while for the other trial values :

L_{10}	$\xi = 1$	$\eta = 0$
L_{20}	$\xi = 2$	$\eta = 0$
L_{01}	$\xi = 0$	$\eta = 1$
L_{02}	$\xi = 0$	$\eta = 2$
L_{11}	$\xi = 1$	$\eta = 1$

Substituting these values of ξ and η in equation (i) we obtain the simultaneous equations :

$$\left. \begin{aligned} L_{10} - L_{00} &= a(2x - 1) + 2hy \\ L_{01} - L_{00} &= 2hx + b(2y - 1) \end{aligned} \right\} \quad . \quad . \quad (ii)$$

The solution of equation (ii) will give the values of x and y if the coefficients a , b and h are known. The values of these coefficients can be obtained from the knowledge of the values L_{00} , L_{10} , L_{20} , L_{01} , L_{02} and L_{11} already calculated by the use of the following equations :

$$L_{20} - 2L_{10} + L_{00} = -2a \quad . \quad . \quad . \quad (iii)$$

$$L_{02} - 2L_{01} + L_{00} = -2b \quad . \quad . \quad . \quad (iv)$$

$$L_{11} + L_{00} - L_{01} - L_{10} = -2h \quad . \quad . \quad . \quad (v)$$

This method of approximation is easily generalized for more than two parameters. For s parameters it requires the calculation of $\frac{1}{2}(s+1)(s+2)$ values of L , and these must be calculated with somewhat high precision, since their second differences are to be used.

Application to Pearson's Type I Frequency Distribution.

Pearson's Type I frequency distribution is usually given in the form

$$y = y_0 \left(1 + \frac{x}{l_1}\right)^{m_1} \left(1 - \frac{x}{l_2}\right)^{m_2}$$

where $y_0 = \frac{1}{l_1 + l_2} \cdot \frac{m_1^{m_1} \cdot m_2^{m_2}}{(m_1 + m_2)^{m_1 + m_2}} \cdot \frac{(m_1 + m_2 + 1)!}{m_1! m_2!}$.

l_1 and l_2 represent distances from the mode of the start and end of the curve, and x is expressed as deviation from the mode.

This equation can be simplified if, instead of expressing x as deviation from the mode, we express it directly as given by the observations.

In this form the equation can be written as :

$$y = y_0(x - \alpha)^{\mu_1}(\beta - x)^{\mu_2}$$

where α is the start of the curve and β the terminus; μ_1 and μ_2 are put instead of m_1 and m_2 to show that these indices are parameters. m_1 and m_2 may be used to indicate their estimates obtained by the method of moments.

The value of y_0 can be calculated thus :

$$df = y_0(x - \alpha)^{\mu_1}(\beta - x)^{\mu_2} dx \quad \dots \quad (i)$$

Put $z = \frac{x - \alpha}{\beta - \alpha}$

then, $dz = \frac{dx}{\beta - \alpha}$

$$x - \alpha = z(\beta - \alpha); \beta - x = (\beta - \alpha)(1 - z).$$

Substituting these values in equation (i) we have

$$df = y_0 z^{\mu_1} (\beta - \alpha)^{\mu_1} (\beta - \alpha)^{\mu_2} (1 - z)^{\mu_2} (\beta - \alpha) dz.$$

Now as the total frequency is unity,

$$\begin{aligned} 1 &= y_0 (\beta - \alpha)^{\mu_1 + \mu_2 + 1} \int_0^1 z^{\mu_1} (1 - z)^{\mu_2} dz \\ &= y_0 (\beta - \alpha)^{\mu_1 + \mu_2 + 1} B(\mu_1 + 1, \mu_2 + 1) \\ &= y_0 (\beta - \alpha)^{\mu_1 + \mu_2 + 1} \frac{\Gamma(\mu_1 + 1) \Gamma(\mu_2 + 1)}{\Gamma(\mu_1 + \mu_2 + 2)} \end{aligned}$$

or $y_0 = (\beta - \alpha)^{-\mu_1 - \mu_2 - 1} \cdot \frac{(\mu_1 + \mu_2 + 1)!}{\mu_1! \mu_2!} \quad \dots \quad (ii)$

In order to estimate the values of the four parameters α , β , μ_1 and μ_2 by the method of maximum likelihood it is necessary to calculate fourteen new and different values of L in addition to one given by the moment solution. The number 15 is obtained by putting $s = 4$ in the general formula $\frac{1}{2}(s+1)(s+2)$.

It will be shown that by suitably choosing the interval (*i.e.* increments to be given to α , β , μ_1 and μ_2 separately) the arithmetical labour of calculation of these different values of L can be reduced to a minimum. The method will be clear from its application to the frequency distribution of fibre-strength of 1,000 fibres of an Indian cotton, to which Pearson's Type I curve was fitted (6) by the method of moments.

The estimates of the four parameters for this distribution, as obtained by the method of moments, are :

$$\alpha = 0.3298$$

$$\beta = 16.67375$$

$$\mu_1 = 0.702432$$

$$\mu_2 = 4.948333$$

Starting from this inefficient moment solution it is required to obtain the maximum likelihood solution of these parameters.

The calculations necessary for evaluating each L may be divided into three steps: (1) the calculation of mid-ordinates, (2) calculation of values of p_x from the mid-ordinates and (3) the calculation of L from the equation $L = S(n, \log p_x)$.

(i) The calculation of mid-ordinates.

The mid-ordinates were calculated from the equation :

$$\log y = \log (\beta - \alpha)^{-\overline{\mu_1 + \mu_2 + 1}} + \log \frac{\overline{\mu_1 + \mu_2 + 1}!}{\mu_1! \mu_2!} + \mu_1 \log (x - \alpha) + \mu_2 \log (\beta - x).$$

The process of obtaining the values of $\log y$ for the fourteen values of L in addition to that of L_{0000} is illustrated in Table I, in which any new value to be calculated in each case is indicated by a \times .

L_{0000} indicates the moment solution, L_{1000} shows that one increment is given to α , while β , μ_1 and μ_2 are unaltered; L_{0100} shows that one increment is given to β keeping α , μ_1 and μ_2 unchanged. Similarly, L_{1100} indicates that both α and β are given one increment each (these increments correspond to those given in the case of L_{1000} and L_{0100}), while μ_1 and μ_2 are left unaltered.

The only laborious calculations in the evaluation of $\log y_0$ are the calculation of log gamma functions, and it will be seen from the table that with the exception of $\log \Gamma(\mu_1 + \mu_2 + 2)$ for L_{0011} , these need not be calculated for the last six values of L , and for those values of L in which μ_1 or μ_2 is not changed.

TABLE I.
Calculation of $\log y$ for different L 's.

L .	$\log y_0$.						$\mu_1 \log (x - a)$.		$\mu_2 \log (\beta - x)$.	
	$\mu_1 + 1$.	$\log (\beta - a)$.	$\frac{(\mu_1 + 1)}{\mu_1 \times \log (\beta - a)}$.	$\log \Gamma(\mu_1 + 2)$.	$\log \Gamma(\mu_1 + 1)$.	$\log \Gamma(\mu_1 + 1)$.	Column of $\log (x - a)$.	Column of $\mu_1 \log (x - a)$.	Column of $\log (\beta - x)$.	Column of $\mu_2 \log (\beta - x)$.
L_{0000}	×	×	×	×	×	×	×	×	×	×
L_{1000}		×	×				×	×		
L_{2000}		×	×				×	×		
* L_{0100}		×	×							
* L_{0200}		×	×							
† L_{0010}	×		×	×	×					
† L_{0020}	×		×	×	×					
† L_{0001}	×		×	×		×				
† L_{0002}	×		×	×		×				
L_{1100}		×	×							
L_{1010}			×							
L_{1001}			×							
L_{0110}			×							
L_{0101}			×							
L_{0011}	×		×	×						

* The values of $\mu_2 \log (\beta - x)$ were obtained by simply shifting the frequencies, since the interval chosen was equal to the class interval.

† Since the interval in μ_1 was 0.1, the values for $\mu_1 \log (x - a)$ were obtained by adding $\frac{1}{10} \log (x - a)$ to the value for L_{0000} .

‡ Similarly, the interval for μ_2 being 0.25, values of $\mu_2 \log (\beta - x)$ were obtained by adding $\frac{1}{4} \log (\beta - x)$ to the values for L_{0000} .

The only calculation involving the frequencies is to build up a column of figures for $\mu_1 \log (x - a)$ and $\mu_2 \log (\beta - x)$ for each class interval, which when added to $\log y_0$ provide the column for $\log y$. In the case of L_{0000} these columns are given by the moment solution, and of these the column $\mu_1 \log (x - a)$ can be used in those cases of L where μ_1 and a are unchanged, i.e. for L_{0100} , L_{0200} , L_{0001} , L_{0101} and L_{0002} , while the column $\mu_2 \log (\beta - x)$ can be used where μ_2 and β are unaltered, i.e. for L_{1000} , L_{2000} , L_{0010} , L_{1010} and L_{0020} . For the remaining four values of L , the columns of $\log y$ can be obtained by combining the column of $\mu_1 \log (x - a)$ of one L with the $\mu_2 \log (\beta - x)$ column of another suitable L ; thus for L_{1001} the column $\mu_1 \log (x - a)$ for L_{1000} and $\mu_2 \log (\beta - x)$ for L_{0001} can be used. Similarly in the case of L_{0011} , the columns for L_{0010} and L_{0001} can be utilized. In some cases, however, as in the present example, by suitably choosing the interval (increments to be given to β , μ_1 and μ_2) it is not necessary to calculate the columns of $\mu_1 \log (x - a)$ for L_{0010} , L_{0020} ; and $\mu_2 \log (\beta - x)$ for L_{0100} , L_{0200} , L_{0001} , L_{0002} . It will be seen from the table that out of twenty-eight columns only two have been calculated (for L_{1000} and L_{2000}), and the rest have been obtained from the columns of $\mu_1 \log (x - a)$

and $\mu_2 \log (\beta - x)$ provided by the moment solution. Thus columns of $\log y$ can be built up for all the values of L in a very short time, especially if an adding machine is available.

(ii) Calculation of values of p_s from the mid-ordinates.

For this purpose the area for each class interval was calculated from mid-ordinates by a simple quadrature formula :

$$\int_{-\frac{1}{2}}^{\frac{1}{2}} y_r dx = y_0 - \frac{1}{2} \delta^2 y_0,$$

which was found to be adequate for all the frequency classes, except the first, for which the area was calculated by subtraction from the total frequency unity.

(iii) The logarithm of the values of p , found in (ii) are multiplied by the corresponding observed frequency n , in that class interval and the sum of these products gives the required L . If a calculating machine is available this sum can be obtained in a very short time without recording separately the individual products $n_s \log p_s$ for each class.

The different values of L obtained by this process are :

(i) L_{0000} (moment solution)	= - 947.134306
(ii) α varying, β, μ_1, μ_2 constant.	
$\alpha = 0.39480$	$L_{1000} = - 946.559780$
$\alpha = 0.45980$	$L_{2000} = - 946.660108$
(iii) β varying, α, μ_1, μ_2 constant.	
$\beta = 15.67375$	$L_{0100} = - 951.186113$
$\beta = 17.67375$	$L_{0100} = - 947.994989$
(iv) μ_1 varying, α, β, μ_2 constant.	
$\mu_1 = 0.602432$	$L_{0010} = - 949.988346$
$\mu_1 = 0.802432$	$L_{0010} = - 947.203417$
(v) μ_2 varying, α, β, μ_1 constant.	
$\mu_2 = 4.698333$	$L_{0001} = - 946.866042$
$\mu_2 = 4.448333$	$L_{0002} = - 948.368457$
(vi) α, β varying, μ_1, μ_2 constant.	
$\alpha = 0.39480 \quad \beta = 17.67375$	$L_{1100} = - 948.021911$
(vii) α, μ_1 varying, β, μ_2 constant.	
$\alpha = 0.39480 \quad \mu_1 = 0.802432$	$L_{1010} = - 947.507773$
(viii) α, μ_2 varying, μ_1, β constant.	
$\alpha = 0.39480 \quad \mu_2 = 4.698333$	$L_{1001} = - 946.816972$
(ix) β, μ_1 varying, μ_2, α constant.	
$\beta = 17.67375 \quad \mu_1 = 0.802432$	$L_{0110} = - 950.398053$
(x) β, μ_2 varying, μ_1, α constant.	
$\beta = 17.67375 \quad \mu_2 = 4.698333$	$L_{0101} = - 949.875851$
(xi) μ_1, μ_2 varying, α, β constant.	
$\mu_1 = 0.802432 \quad \mu_2 = 4.698333$	$L_{0011} = - 948.480784$

It may be noted that both the trial values of α (0.39480, 0.45980) are on the positive side of the value of α (0.3298) for the moment solution. The reason for this is that for the moment value $L = -947.134306$, and for $\alpha = 0.39480$, $L = -946.559780$, a *higher* value, consequently to get a lower value of L (*i.e.* after it has passed the maximum) α should be given another increment in the *same* direction. In fact $\alpha = 0.45980$ has given a lower value of $L = -946.660108$. Hence these values of α are on either side of the maximum likelihood solution. For similar reasons the two values of μ_2 are on the negative side of the moment value. This alteration in no way changes the scheme of calculation outlined in Table I, if the appropriate increments (positive or negative) are substituted.

These values of L provide four simultaneous equations for the required increments x , y , z and w to be added to the moment-estimates of α , β , μ_1 and μ_2 in the form :

$$\begin{aligned} 2ax + 2ey + 2fz + 2gw &= L_{1000} - L_{0000} + a = 0.911953 \\ 2er + 2by + 2hz + 2iw &= L_{0100} - L_{0000} + b = 1.595562 \\ 2fx + 2hy + 2cz + 2jw &= L_{0010} - L_{0000} + c = 1.392465 \\ 2qx + 2iy + 2jz + 2dw &= L_{0001} - L_{0000} + d = -1.153604 \end{aligned}$$

where the values of the ten coefficients a , b , c , d , e , f , g , h , i and j are all obtained from the values of L by the following equations :

$$\begin{aligned} \text{I. } L_{2000} - 2L_{1000} + L_{0000} &= -2a \quad a = 0.337427 \\ \text{II. } L_{0-100} - 2L_{0000} + L_{0100} &= -2b \quad b = 2.456245 \\ \text{III. } L_{00-10} - 2L_{0000} + L_{0010} &= -2c \quad c = 1.462526 \\ \text{IV. } L_{0002} - 2L_{0001} + L_{0000} &= -2d \quad d = 0.8853395 \\ \text{V. } L_{1100} + L_{0000} - L_{0100} - L_{1000} &= -2e \quad e = 0.300724 \\ \text{VI. } L_{1010} + L_{0000} - L_{0010} - L_{1000} &= -2f \quad f = 0.439441 \\ \text{VII. } L_{100-1} + L_{0000} - L_{000-1} - L_{1000} &= +2g \quad g = -0.262728 \\ \text{VIII. } L_{0110} + L_{0000} - L_{0010} - L_{0100} &= -2h \quad h = 1.1669765 \\ \text{IX. } L_{010-1} + L_{0000} - L_{000-1} - L_{0100} &= +2i \quad i = -1.074563 \\ \text{X. } L_{001-1} + L_{0000} - L_{000-1} - L_{0010} &= +2j \quad j = -0.7728155 \end{aligned}$$

The values of x , y , z and w obtained from these four symmetrical equations are multiplied by the appropriate units in order to get the "corrections."

	Units.	
$x = +1.19635$	0.065	$x' = +0.07776$
$y = +0.12573$	1.00	$y' = +0.12573$
$z = -0.111025$	0.10	$z' = -0.011103$
$w = -0.24078$	0.25	$w' = -0.060195$

The estimates of the parameters α , β , μ_1 and μ_2 by the two methods are :

Parameter.	Method of Moments.	Method of Maximum likelihood (first approximation)
α	0.32980	0.40756
β	16.67375	16.79948
μ_1	0.702432	0.691329
μ_2	4.948333	4.888138

The theoretical frequencies obtained by using these two sets of estimates in the Type I equation are given in Table II, where for the sake of comparison χ^2 is also evaluated.

TABLE II.
Theoretical Frequency Distribution.

(Type I obtained by the method of moments and method of maximum likelihood.)

Strength-class, Grams.	Observed Fre- quency. m	Theoretical Frequency.		Calculation of χ^2 .			
		Method of Moments, m'	Method of Maximum Likeli- hood, m''	Method of Moments.		Method of Maximum Likelihood.	
				$m - m'$	$\frac{(m - m')^2}{m'}$	$m - m''$	$\frac{(m - m'')^2}{m''}$
0.0 - 0.95	38	49.04	42.06	-11.04	2.4853	-4.06	0.3880
0.95- 1.95	165	156.52	154.94	8.48	0.4594	10.06	0.6531
1.95- 2.95	188	179.38	181.50	8.62	0.4142	6.50	0.2328
2.95- 3.95	159	166.19	168.80	-7.19	0.3111	-9.80	0.5689
3.95- 4.95	137	138.89	140.77	-1.89	0.0254	-3.77	0.1009
4.95- 5.95	114	107.08	108.76	6.92	0.4472	5.24	0.2524
5.95- 6.95	81	77.01	78.65	3.99	0.2067	2.35	0.0702
6.95- 7.95	48	53.08	53.32	-5.08	0.4861	-5.32	0.5371
7.95- 8.95	29	34.48	33.68	-5.48	0.8709	-4.68	0.6502
8.95- 9.95	19	19.85	19.66	-0.85	0.0364	-0.66	0.0222
9.95-10.95	15	10.61	10.40	4.39	1.8164	4.60	2.0334
above 10.95	7	7.87	7.46	-0.87	0.0961	-0.46	0.0283

$$\left. \begin{array}{l} \chi^2 \\ P \\ L \end{array} \right\} n = 7 \quad \begin{array}{l} 7.6552 \\ (0.371) \\ -947.134306 \end{array} \quad \begin{array}{l} 5.5375 \\ (0.596) \\ -946.494469 \end{array}$$

A number of interesting points which emerge from the study of this table are given below :

(1) The likelihood of the set of values obtained by the first approximation method is higher than any of the trial sets.

(2) From the columns giving the contribution to χ^2 of individual classes it will be noticed that the value 2.4853 for the first class interval has been reduced to 0.3880, thus improving the fit of the theoretical curve.

(3) From the values of χ^2 , P it can be concluded that the maximum likelihood solution has given a better fit also as judged by the χ^2 test than that obtained by the method of moments.

Of the value of χ^2 obtained from the method of moments, about 2.1, or over a quarter of its value, is ascribable to inefficient fitting.

It should be noted that as shown (2) by Fisher in the calculation of P , n should be equal to the number of degrees of freedom. The values of P have been calculated from the table of χ^2 given (5) in *Statistical Methods for Research Workers*, using $n = 7$.

(4) Evidently if for any reason higher precision were required, the process could be repeated with trial values nearer to the maximum likelihood solution.

Summary.

A method is given for the improvement of inefficient statistics obtained by the method of moments. It consists in the evaluation of a number of L 's directly from the equation $L = S(n, \log p)$. For the estimation of S parameters it requires the calculation of $\frac{1}{2}(S+1)(S+2)$ values of L . These values of L provide simultaneous equations from which the corrections to be added to the moment estimates of the parameters can be calculated. The method is illustrated by its application to a coarsely-grouped skew distribution to which Pearson's Type I was fitted by the method of moments. It is shown that the calculation of additional fourteen values of L is not laborious, as most of the material for this calculation is provided by the moment solution.

I am highly indebted to Dr. R. A. Fisher, Sc.D., F.R.S., for suggesting to me this problem, and for the very valuable advice which he has given at every important step. My thanks are also due to the Indian Central Cotton Committee for providing facilities to work at the Rothamsted Experimental Station.

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A QUANTITY INDEX-NUMBER.

By E. C. RHODES, D.Sc.

MR. NORMAN CRUMP posed the following question to Mr. Macrosty in a discussion on a paper by the latter on "The Overseas Trade of the United Kingdom, 1924-1931," read before the Society on May 24, 1932: "What justification was there for using prices as weights for a volume index-number?" (see p. 654, *J.S.S.*, Part IV, 1932). Mr. Macrosty not being able in the short time at his disposal to give a full answer to this question, but the question raised being of great importance, it is worth while to attempt to resolve this difficulty.

The problem really arises through the double use of the word "weight." We are taught in elementary statistics about a weighted average, and the word has been introduced on account of the likeness of the weighted average problem to the calculation of the centre of gravity in mechanics, and one supposes that the older statisticians, having had a training in "Applied Mathematics," recognized this likeness, and probably illustrated their elementary lectures with a uniform bar, different weights and a knife-edge. When Index-Numbers were thought of, it was recognized that the weighted average was the proper kind of average which should be used and not the simple average, consequently the word "weights" began to be used when talking about Index-Numbers. The process follows these lines: We are concerned with price changes in a number of commodities (say) from one year to another. We can make a comparison of changes of price in wheat, beef, pig iron, and so on, and we can express these for the second year relative to the first as percentages. Thus we have a series of figures of this kind:

Relative Price.

				Year (0).	Year (1).
				—	—
Commodity A	...	...		100	110
" B	...	...		100	115
" C	...	...		100	95

Our problem is to get an average of the 110, 115, 95, . . . , a figure which will indicate the general change which has taken place from year (0) to (1) and thus serve as an "Index-Number" of the general level of prices. But we feel certain that a simple average will not do, we must take account of the different degrees of importance of

the items we are averaging; that is, we must take account of the relative importance of the different commodities A, B, C, Herein lies the main difficulty encountered in making Index-Numbers. How are we to judge the relative importance of the different commodities? The answer is that the only *medium* in which this may be measured is one of *value*. We cannot compare tons of coal with bushels of wheat or barrels of beer, but we can compare the amounts of money spent on quantities of these purchased or consumed, on the ground that the relative amounts of money spent on different commodities indicate the relative importance attached to these different commodities in the mind of the consumer. These value figures, then, give us "weights" for our weighted average, the "weights" indicating the relative importance of the different items which we are averaging. Thus, in the general case, if p_0 and p_1 represent prices of a commodity in the first and subsequent year and V is the value, the items are $\frac{p_1}{p_0} \times 100$ for each commodity and the weights are the appropriate V 's. The weighted average is

$$\frac{\sum \frac{p_1}{p_0} \times 100 \times V}{\sum V},$$

and this is called the Index-Number.

So, if we are dealing with any other problem, we proceed in the same way. For instance, suppose we are concerned with the change in *volume* of imports. Our items to be averaged are a series of $\frac{q_1}{q_0} \times 100$, where q_0 , q_1 represent the quantities of goods of a certain kind imported in the first and subsequent years. The "weights" to be used in the averaging process are a series of values (V) indicating the relative importance of these different goods, the weighted average

$$\frac{\sum \frac{q_1}{q_0} \times 100 \times V}{\sum V}$$

is called the volume Index-Number.

Similarly if we want an Index of Production. We have a number of items $\frac{O_1}{O_0} \times 100$, where O_0 , O_1 , represent the Output, in whatever units are used, of the different commodities produced. We realize that the average should be a weighted average and the "weights" used are values (again because value is the only reasonable medium of comparison), these values (V) being the Net Outputs

of the different industries producing these commodities. The weighted average

$$\frac{\Sigma \frac{O_1}{O_0} \times 100 \times V}{\Sigma V}$$

is called the Index of Production.

Now when we are dealing with Import figures (say), we may find the actual arithmetic easier if the formula used is changed into a different shape. We have data in their original form of quantities and values. Prices are "secondary" statistics. For a commodity, then, we have :

First year.	Subsequent year.
$q_0, V_0, p_0 - \frac{V_0}{q_0}.$	$q_1, V_1, p_1 - \frac{V_1}{q_1}.$

Now, suppose we are going to calculate a volume Index-Number,

$$\frac{\Sigma \frac{q_1}{q_0} \times 100 \times V}{\Sigma V},$$

and we agree that the V 's to use are those pertaining to the first year, *i.e.* the V_0 's, then the Index-Number is

$$\frac{\Sigma \frac{q_1}{q_0} \times 100 \times V_0}{\Sigma V_0}.$$

but since $V_0 = p_0 q_0$ we may write this

$$\frac{\Sigma q_1 p_0 \times 100}{\Sigma q_0 p_0},$$

and actually in some cases it may simplify the arithmetic, or, for some other reason which does not arise here, may be preferable to use this form rather than the original form of the Index-Number. Now this form is probably more often quoted than the original, and reference is often made to it as a "weighted Index-Number, the 'weights' being the prices." Of course this does no harm when people are clear that it is merely a "derived" formula and when they appreciate that the word "weights" is being used loosely and *in a different sense from its use in a weighted average*. Naturally, it does seem strange that "weights" can be prices. Somehow it does not seem that there is anything wrong when we get the same sort of derived formula used for price Index-Numbers in this way : The

original formula using (say) the first year's values as weights in the weighted average, viz.:

$$\frac{\Sigma p_1 \times 100 \times V_0}{p_0 \Sigma V_0}$$

reduces to

$$\frac{\Sigma p_1 q_0 \times 100}{\Sigma p_0 q_0},$$

and here the multipliers in the numerator and denominator are quantities, which sometimes are weights in tons, hundredweights, pounds, and there seems nothing offensive in speaking of a "weighted Index-Number where the 'weights' are quantities."

The trouble can be avoided if the word "weight" is reserved for the weighted average, the result of dividing the sum of the products of the items times the weights, by the sum of the weights. When we use these derived formulæ in the calculation of certain Index-Numbers, let us use the word "multiplier," and say, for instance, that the volume Index-Number to which reference has already been made is the result of dividing the sum of the products of the subsequent year's quantities by multipliers which are the first year's prices, by the sum of the products of the first year's quantities by these same multipliers.

The confusion between these two formulæ, the original weighted average and the derived formula, is definitely real and leads to other difficulties not raised by Mr. Crump. For instance, one sometimes finds a tendency on the part of those not properly initiated into the mysteries of Index-Numbers to proceed on these lines: they are working an average of price relatives, and they obtain these $\frac{p_1}{p_0} \times 100$ and then calculate a weighted average, using "weights" which are quantities instead of values, and obtain a result

$$\frac{\Sigma p_1 \times 100 \times q_0}{p_0 \Sigma q_0}.$$

Here, of course, they are getting a heterogeneous mixture in the numerator and denominator, adding tons of coal to tons of pig iron, to tons of wheat and so on. They often do not observe the mistake they are making until barrels of beer or eggs (measured in great hundreds) are to be introduced into the mixture. These heterogeneous totals may, of course, interest a railway company, but cannot interest an Index-Number calculator. The mistake has arisen through confusion between "weights" of a weighted average and

“ weights ” of a weighted Index-Number. The term “ weighted Index-Number ” should never be used.

The answer to Mr. Crump is that prices are not used as “ weights ” in calculating a volume Index-Number. The “ weights ” which are used are Values, properly, since Value is the only medium of comparison of one commodity with another. In the derived formula which Mr. Crump quotes, prices are being used as “ multipliers.”

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS.

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1.—*Monetary Theory and the Trade Cycle*. By Friedrich A. Hayek, Tooke Professor of Economic Science and Statistics in the University of London. Translated from the German by N. Kalder and H. M. Croome. Bedford Economic Series. London: Jonathan Cape. 1933. 7½ × 4½; 244 pp. 6s. net.

Professor Hayek's recently translated book on Monetary Theory and the Trade Cycle is an expanded version of a paper prepared for the meeting of the Verein für Sozialpolitik held in Zürich in September 1928. It was originally written, that is to say, before his now widely known "Prices and Production," and as might be expected the later work develops further the ideas which are here expressed in mere outline.

After a brief general chapter on the Problem of the Trade Cycle, Professor Hayek goes on to consider certain non-monetary theories which have been produced in explanation of the cycle. As he says in his preface, in Germany monetary explanations of the Trade Cycle have been, at least until quite recently, regarded with some mistrust. Writing, as he was in the first instance, for a German-speaking public, he emphasizes the necessity of a monetary approach to the problems rather more than he feels is necessary for English readers. His handling of the various theories dealt with is, however, only brief. Actually his answer to all of them is fundamentally the same. In his view they all fail to show what it is that nullifies the tendency towards equilibrium and why the forces set up by the various mal-adjustments should be self-perpetuating instead of holding within themselves the seed of self-correction through the reactions of supply and demand. The gist of his argument is that disequilibrium in the economic structure can only be induced by monetary causes since "money being a commodity which, unlike all others, is incapable of finally satisfying demand, its introduction does away with the rigid

interdependence and self-sufficiency of the 'closed' system of equilibrium, and makes possible movements which would be excluded from the latter."

Having considered non-monetary theories, the author then goes on to consider various monetary theories of the Trade Cycle. Both the arguments he discusses and his own criticisms of them are put so briefly that any reader not familiar with the works he cites will find it difficult to get a clear idea of the theories he seeks either to refute or develop. The point he chiefly emphasizes is that it is misleading to consider only changes in general price levels, changes originating in the monetary field "are bound to disturb the equilibrium inter-relationships existing in the natural economy, *whether the disturbance shows itself in a change in the so-called 'general value of money' or not.*"

The most important chapter of the book, however, is naturally that in which the author elaborates his own views on causes of cyclical fluctuations. Frankly, it must be confessed the arguments in this chapter are so condensed that taken by itself it is far from satisfactory. The crux of his thesis is that maladjustments which must lead to a crisis are inevitable if the banks by credit creation induce a rate of interest lower than the natural rate which just equates savings and investment. He shows that this will lead to more cash being withdrawn from the banks, and continues: "this phenomenon is easily explained in theory by the fact that a low rate of interest first raises the price of capital goods and only subsequently those of consumption goods, so that the first increases occur in the kind of payments which are effected in large blocks. It may lead to the consequence that banks are not only prevented from granting new credits, but even forced to diminish credits already granted. This fact may well aggravate the crisis; but it is by no means necessary in order to bring it about. For this *it is quite enough that the banks should cease to extend the volume of credit*: and sooner or later this must happen. Only so long as the volume of circulating media is increasing can the money rate of interest be kept below the equilibrium rate; once it has ceased to increase, the money rate must, despite the increased total volume in circulation, rise again to its natural level and thus render unprofitable (temporarily at least) those investments which were created with the aid of additional credit" (pp. 175, 176).

The above passage has been quoted at length partly because it is very much the heart of the matter, and partly because it shows how very elliptical is the author's reasoning. The conclusion that credits must be continuously increased if the rate of interest is to be kept below the natural rate, and that a mere continuance of the first inflated level of credit is not enough, is by no means entirely obvious on the surface, and since this conclusion is the very essence of the author's theory it is curious that he should not fill in the intermediate steps in his reasoning. It is true he returns to this line of argument thirty pages later but even there the argument is not fully elaborated. The fact is, that to realise his line of thought it is really necessary to know the arguments put forward in his "Prices and Production." In the preface to the book now under consideration

Professor Hayek states that "Prices and Production" should be regarded as an essential complement to the present publication. But that is somewhat understating the matter. It is rather true that without a preliminary knowledge of "Prices and Production," this study of the Trade Cycle must seem in more than one section a collection of hypotheses and final conclusions with the intervening arguments but sketchily indicated.

Whether Professor Hayek's views on industrial fluctuations form an epoch-making contribution to economic theory or not is a question on which views differ profoundly, and it is manifestly impossible to do justice to either side of the argument in a brief review; indeed any attempt to do so would go far beyond the limits of a review of the book under consideration and would develop into a review of "Prices and Production." All that can be said is that this new publication is hardly likely to change the views of those who were unconvinced by "Prices and Production," whilst those who are unfamiliar with that work will be better advised to turn to that for a summary of Professor Hayek's views rather than to this new publication. But though this study of the Trade Cycle can hardly be regarded as complete in itself, it remains true that Professor Hayek's point of view is so individual and in many ways so fresh that, whether one finds his arguments conclusive or not, they act as a potent stimulant to thought and one can well understand why Professor Robbins considered the book worth including in his "Bedford Series" of translations.

W. A. E.

2. -*The Art of Central Banking.* By R. G. Hawtrey. London: Longmans, 1932. 9" x 5 $\frac{3}{4}$ ". xii + 464 pp. 18s.

This volume is composed of eight essays in as many chapters—French Monetary Policy, Speculation and Collapse in Wall Street, Consumers' Income and Outlay, the Art of Central Banking, Money and Index-Numbers, Mr. Keynes' *Treatise on Money*, International Short-Term Investment, and Remedies for Unemployment. The last three were prepared for the Macmillan Committee, and of the others the first, third, and fifth have been previously published—the fifth was read before this Society in December, 1929. This is a bill of fare which should satisfy any appetite, but to work one's way through it would take a long time and to sample each course would induce mental indigestion. It must suffice here if we take a few nibbles at what may, without disrespect, be called the "joint," the essay on the Art of Central Banking, which occupies 187 pages. Most people have a general idea that a Central Bank is "the bankers' bank" and is responsible for the note-issue, and that if it were not so wicked or incompetent it could cure most of our monetary troubles. Even if such a person were able to read only the first half of Mr. Hawtrey's essay he would have a much clearer idea of the working of the system, and having managed so much he would be well advised to struggle through to the end even if he should find some of Mr. Hawtrey's opinions disagree with him.

Mr. Hawtrey points out that "the Central Bank is the lender of last resort"; to it in times of need the other banks come for supplies

of credit and currency. It was a long time before the Bank of England assumed these responsibilities. Except for its Government connection it comported itself as an ordinary bank, it sought to protect its gold reserve, and it only discounted bills (in its early days, internal bills) when the other banks had enough. When there was a crisis and credit was demanded it rationed discounts as in 1795. In 1825, at the instance of the Government, it issued notes to merchants on the security of their goods, but in the crisis of 1847, when the Bank was faced with the exhaustion of its reserve, it was authorised by the Government "to enlarge the amount of their discounts and advances on approved security." By the crisis of 1866 the function of ultimate lender was fully accepted, and Bagehot in 1873 placed the policy in an impregnable position.

Quite early the Bank of England realised that it could affect prices by manipulating the Bank Rate; raising the rate restricted borrowing, limited transactions, and reduced prices, thus stimulating exports and stopping the drain of gold. After 1847 the lesson of keeping an adequate reserve was learned. That a high Bank Rate was a means of attracting foreign money for use in London was recognized before 1857, but Goschen pointed out that it was of limited utility.

"What governs demand in any community is the consumer's income (the total of all incomes expressed in terms of money) and consumers' outlay (the total of all disbursements out of income including investments)." "The purpose of an expansion of credit is to increase the 'supply' of money . . . the flow of money spent in commodities." When a trader increases his purchases he releases cash and stimulates production, and the price he pays for the additional supply forms the producers' incomes, thus in turn (as producers are consumers) augmenting the total of consumers' income. The trader can only obtain the cash for his additional purchases by borrowing from his banker. He is thus exceedingly sensitive to the dearth or cheapness of credit, but the producer is less affected. When traders start buying in anticipation of a demand, prices of natural products will rise as supply cannot be readily increased, but in the case of manufactures increase of prices will depend upon whether the producers are already working close to capacity. The banks can only increase credit up to the maximum limit of production; the cycle of activity is marked first by soaring prices and then by deflation; credit is inherently unstable. The Central Bank, by purchases or sales of securities (increasing or decreasing bankers' balances), can regulate the credit given by the other banks, but it must also use the Bank Rate in order to prevent its operations being offset by decreases or increases of rediscounting. It should take into account the instability of credit and try to check the tendency to expansion or contraction, though sometimes it must act more forcibly to reverse a movement. When bank rates are too low it shows that business is so unprofitable that no one will borrow. The Central Bank should then "inject money" into the system by buying securities, etc., thus swelling bankers' reserves and making them more ready to lend or to finance new issues.

Under the pre-war *régime* the duty of the Central Bank was to maintain the Gold Standard, but, as we have seen, its efforts to prevent a drain of gold had important reactions on prices and employment. Consequently, the abandonment of gold and the regulation of currency and credit by a "tabular standard" for the purpose of maintaining a constant level of internal prices was originated in principle by Walras in 1886 and has now become practical politics. With a free bill market London became the regulator of international credit. "The active phase of the trade cycle is the result of the banking system (under the guidance of the Central Bank) increasing the supply of money. It is this increase in the supply of money that accounts both for increased productive activity in response to the swollen demand and for the rise in the price level. . . . The governing condition on which everything else depends is the enlargement of the consumers' income and outlay. What stops that enlargement is the shortage of gold reserves. . . . Eventually the central banks were bound to put on the brake. They would start contracting credit, and there would follow a compression of the consumers' income and outlay. . . . Contraction had to proceed till the deficiency of gold had been corrected."

A brilliant sketch of financial history from 1925 follows, including the American attempt at stabilization in 1922-28, with some mordant comments on the policies of the authorities. What is the conclusion? "The gold standard *has* become intolerable." "The underlying cause of the trouble has been *monetary instability*. The industrial depression and unemployment, the insolvencies, bank failures, budget deficits and defaults, are all the natural outcome of a falling price level." "The need arises for an *international lender of last resort*." "One lesson to be learnt from the experience of the last few years is the survival of the old-established position of London as an international credit centre." London, therefore, has special responsibilities. "It may be confidently predicted that there will presently be a big rise in the world-price level in terms of gold." The final word is "stable money."

No doubt Mr. Hawtrey will say that this notice, even regarded as an outline, has avoided many important contours. That is quite true, but, varying the original metaphor, the object has been to suggest to the reader that there is much more of importance in his geography than has been touched on here. Much as we disagree with Mr. Hawtrey on many points we can conscientiously say, in the old Roman phrase, that he has "deserved well of the community."

H. W. M.

3.—*Gold and Monetary Stabilization*. Lectures on the Harris Foundation. 1932. Editor, Quincey Wright. By Jacob Viner, Gottfried Haberler, H. Parker Willis, Lionel D. Edie, John H. Williams. University of Chicago Press (London: Cambridge University Press), 1932. 7½" × 5". xi + 174 pp. 11s.

This little volume on Gold and Monetary Stabilization consists of five lectures delivered in Chicago early in 1932. The contributions which will most interest English readers are unquestionably those

which deal with specifically American conditions. Both Professor Parker Willis and Mr. Edie are definitely critical of the Federal Reserve System, the burden of both their criticisms being that it cannot adequately control business activity. Professor Parker Willis maintains that neither the open-market operations of the Federal Reserve System nor its inactivity "has had any perceptible or traceable connection with the current of domestic events." The fundamental flaw, he considers, is the imperfect means of access granted to the public with respect to Reserve banks, which are bankers' banks and "deal only with member institutions, or, more truly stated, are stock-market banks, which have so restricted their own field of operations that they cannot reach the rank and file of business institutions even if they would, but must work through the market." Changes of reserve policy consequently operate in the first instance rather upon foreign exchange business than on the home trade, and, Professor Willis continues, "there is no possibility of applying the influence of changes in credit costs or of credit volume at those points where they would be likely to be effective." Mr. Edie stresses the unwillingness of the member banks to rediscount with the Federal Bank, and goes so far as to maintain that in essentials the United States is not on the gold standard, since gold has been divorced from credit, the reserve balances of the member banks forming what he calls a buffer between the credit superstructure and the gold base. The last lecture in the book by Professor Williams on Monetary Stability and the Gold Standard also contains some interesting and provocative matter. His main thesis, illustrated by recent American experience, is that there is a logical conflict between the gold standard and domestic monetary stability, the former imposing external control, the latter insisting upon internal control. He refers briefly, but not optimistically, to international co-operation as the only hope of solution.

The other two lectures are of a more general character. Professor Viner deals with International Aspects of the Gold Standard along lines which for the most part will be familiar to all English readers, though he too stresses the failure of member banks to make use of rediscount facilities, which was one of the factors tending to prevent the increase in gold reserves from having its expected influence on the volume of business transactions and on the price level. It may be mentioned in passing that Professor Williams, on the other hand, considers there is little truth in the accusation that the Reserve banks sterilized gold and caused a maldistribution of the world's reserves.

Finally, Mr. Gottfried Haberler contributes a lecture on Money and the Business Cycle of a more theoretical nature and adopts the arguments best known in this country through Hayek's *Prices and Production*. It is an essay which would be stimulating to anyone who is not yet familiar with the reasoning of the Viennese school, and Mr. Haberler would doubtless not claim more for it than that.

A collection of lectures of this kind, each delivered by a different lecturer, is hardly likely to break much new ground, but the book,

nevertheless, will be found valuable for those who want a brief but authoritative survey of the recent practice of the Federal Reserve System.

W. A. E.

4.—*Planned Money.* By Sir Basil P. Blackett. London: Constable & Co., 1932. 7 $\frac{3}{4}$ " \times 5". ix + 194 pp. 5s.

This book is a clear and vigorous plea for a complete transformation of the monetary system under which we at present work. It is intended for popular consumption, and, if many intricacies and qualifications have been left on one side, it gains in simplicity and definiteness of statement so as to make its main proposals easy of comprehension by those who are not steeped in the mysteries of currency theory. This is all to the good, for the more obscure difficulties that lie in the way of any scheme can be tackled with more hope of success when the principles have been clearly grasped. The planning of a new monetary system is to the author only one part of a general economic reconstruction which has become necessary. *Laissez-faire* with its myth of an automatic self-adjusting system has broken down and must be substituted by "conscious control by human agency of the processes of Production, Distribution, and Consumption with a view to securing the maximum opportunities for satisfaction of the greatest possible quantity and variety of human wants." International planning is at present unattainable, but the Ottawa Conference has shown that the wide area of the British Commonwealth of Nations "offers to the world a model of international co-operation capable of wide extension." In Great Britain planning must leave the consumer's choice free. It will leave prices to be determined by demand and will not seek to regulate the relative prices of particular commodities. On the other hand, the keynote of planning in the monetary field is "the maintenance of stability in the price level, and this should involve some smoothing out of those fluctuations of the consumer's purchasing power which are a potent cause of disequilibrium between production and consumption under the existing *régime*." "The breakdown of the existing economic system appears most obviously in the failure of its machinery of distribution," and in creating some new machinery to equate production to demand "each particular industry must be dealt with as a whole, and must organize itself for mutual co-operation and not appear as a medley of competitive atoms," and we must deal with money as the medium of exchange and distribution.

The present monetary system has landed us, according to Sir Basil, in a world-wide catastrophic fall of prices and in unexampled unemployment. We have the choice between trying to stabilize international exchanges with fluctuating internal prices, as in the past, or aiming at the maintenance of the internal price level and leaving the exchanges to look after themselves. The latter is now preferable and is to be secured by providing a local currency with stable purchasing power. To do this we must base the currency on an index-number which "adequately measured the sum of all the most important activities of the economic life of the nation,"

and "it might justly be assumed that an Index-Number framed on the lines of the existing Board of Trade Index Number of wholesale prices would afford a reasonably satisfactory starting-point for purposes of maintaining a Constant Price Level." The base year for such a number should "obviously be one at which economic conditions are in a state of reasonable equilibrium." When prices deviate by more than, say, five per cent. from par the Central Bank should influence the supply of purchasing power (currency and credit) by altering the Bank Rate and by suitable "open-market operations" to take money off, or put it in, the market. Violent fluctuations of the foreign exchanges are to be avoided and they may be minimized by extension of the policy of stable internal prices from Great Britain to other members of the British Commonwealth and to those other countries which have specially close trading relations with the British Empire. A new trading area, "Sterlingaria," might thus be constituted of countries with local currencies each in a stable relation to sterling, which would be strong enough to negotiate with the gold-using countries terms of settlement based on gold so as to eliminate frequent and violent fluctuations of exchange. All the same, trade between "sterling" and "gold" countries would tend to diminish and trade between "sterling" countries to increase. British international lending must also be deliberately planned so as to foster the development of countries supplying food and raw materials in return for manufactures.

Such is a very bare outline of the scheme to secure stable prices, of which Sir Basil would only claim to have written the prospectus (reinforced, we may add, by an appendix on the advantages of a constant price level, consisting of extracts and diagrams from Sir Henry Strakosch's supplement to the *Economist* of July 5, 1930). There is not space here for a detailed examination of the proposals, but one may commend the earlier chapters insisting on the substitution of planning by industries for disorderly competition by units, and agree that price fluctuations should be reduced, without at the same time taking the currency scheme as proved. When the vast body of transactions in securities is excluded from the index as well as retail dealings, wages, services, etc., one hesitates to accept an index-number of wholesale prices as sufficiently summing up "all the most important activities of the economic life of the nation," more especially when existing wholesale index-numbers very imperfectly reflect the price-movements of finished goods and are subject to deformation as the relative importance of industries to each other (which forms the basis of weighting) alters. Further, no year since the war answers the condition of being in a state of sufficient economic equilibrium to make it a satisfactory base year. Again, we have no data on which we can estimate the amount of interference by the Central Bank required to correct divagations from the norm or the time which must elapse before a change in the Bank Rate or appropriate open-market operations can affect wholesale prices. Currency regulation is a delicate matter and it behoves us to go warily until we get much more information than we have at present.

H. W. M.

5.—*The Money Muddle and the Way Out.* By F. W. Pethick-Lawrence. London: Allen and Unwin, 1933. 4½" × 7". 79 pp. 2s. 6d.

Mr. Pethick-Lawrence's new book is a sequel to another small volume—*This Gold Crisis*—and the two may usefully serve to introduce the "man in the street" to the study of monetary problems. During the last eighteen years, he says, the instability of the unit of value "has far exceeded anything experienced before," and its fluctuations are largely responsible for the long-continued depression of trade.

If the gold standard has failed to keep prices reasonably steady it is not a complete answer to say that Governments have not played the game according to the rules. This country must substitute for the gold standard a managed currency based on an index-number of wholesale prices, the actual composition of which he would leave to an expert committee. If other countries are willing to join in setting up an international unit of value they must agree on the composition of an international index-number, in which the quotations would exclude import or export duties. In this way both the foreign exchanges and prices would be stabilized. If other nations refuse to co-operate, then we must sacrifice exchange stability to internal price stability. Mr. Pethick-Lawrence holds that the currency should be varied according to the movements of his index-number through the power of the Central Bank to vary the amount of credit through open-market operations.

Mr. Pethick-Lawrence is frankly in favour of the Liberal-Labour policy of "an increase in Government activity without increase of taxation," which implies a reversal of the movement towards economy. He believes that an increase of Government expenditure will raise wholesale prices without a proportionate rise in retail prices. Incidentally, he wants to repeal the present statutory limit on the fiduciary issue, which he regards as an out-of-date survival from the time when England was on a gold basis. Finally, he wants our Government to put before the World Economic Conference a proposal for linking the currencies of the world to an international group of commodities.

J. E. A.

6.—*Business Statistics.* By Joseph Lyons Snider, Ph.D. London: McGraw-Hill Publishing Co., Ltd., 1932. 9¼" × 6". vii + 498 pp. 3os.

The present edition of this extremely useful work on business statistics brings up to date the collection of statistical analyses assembled by Dr. Snider to illustrate the several forecasting methods which have been applied to business data in the U.S.A. It gives a general picture of the enormous and intricate machinery employed for the collation of the huge mass of factual data, the thousands of detailed compilations and the specialized knowledge devoted to the analysis of group data which have earned for the U.S.A. the reputation abroad of recording statistically almost every feature of her national life from its beginning.

In addition to the above-mentioned specialized services, many

banks, trade associations, and private companies maintain staffs of highly trained "field-men" at strategic points throughout the country, whose duty it is to study industrial conditions at first hand. To say that the practical results of this work have been disappointing is seriously to understate the position. Probably at no time in its history has the art of business forecasting fallen to such a low ebb.

The present volume enables one to understand why this has happened. Though Dr. Snider himself goes out of his way to utter a special warning on the dangers attendant on the use of statistical data "against features which may endanger correct conclusions," and stresses that "statistics are not the whole cure for business ills, or the whole force of business progress," many of the papers included in his book leave the impression that their authors have been confused by the mass of statistical data which they have compiled, and also hold exaggerated ideas as to the value of statistical formulæ they have employed for the purpose of forecasting economic phenomena. Relatively few of the papers show a proper appreciation of the desirability of using statistical material in its proper historic and economic perspective. Charts and statistical tables are analysed *in vacuo* without regard to the position of the industry in the economic framework or to the long-term trend of business development as a whole. Small wonder that the American business man's reverence for statistics and charts has received a shock!

The following is an example of a prognostication which it is hoped was not acted upon in drawing up the production programme of the industry concerned.

Mr. J. W. Seoville, Chief Statistician of the Chrysler Corporation, wrote in January, 1931, that "while in 1930 automobile sales were declining, starting the year about normal, declining to 50 per cent below normal, in 1931 I believe the trend will be reversed and that sales starting at 50 per cent. below normal will show an upward trend and close the year above normal. Nineteen thirty-two should be above normal most of the year, and in my opinion 1932 will show the largest production ever recorded, with the possible exception of 1929."

In contrast to this forecast, however, may be set the General Motor Corporation's more modest estimate of the trend of the automobile industry's domestic passenger car sales, which is in many respects a model of the principles which should be followed in endeavouring to prepare a production forecast for a particular industry.

Taking the book as a whole, one gains the impression that the absence of any satisfactory explanation of such phenomena as the "Trade Cycle" and our ignorance of the conditions governing trade growth are chiefly to blame for the failure of business forecasting. The practice of eliminating secular trend and treating business fluctuations as movements up and down a more or less stationary base line is not easy to justify on practical grounds; nor is the assumption that trade cycle fluctuations can be satisfactorily analysed without taking into account the circumstance that every trade cycle has had its own special centre of industrial activity.

For this reason the utilization of a single or a series of composite

curves has frequently tended to mislead, since the actions and reactions operating within each composite index have masked important changes in general conditions.

Dependence upon a composite index prompted a forecast by the Harvard Economic Service in February, 1931, "that the bottom of the depression would be reached during the first half of 1931."

The section dealing with agriculture, which is one of the best, is of particular interest, as it provides the general reader with a brief survey of the activities of the Bureau of Agricultural Economics, whose forecasts have acquired such a world-wide reputation.

The paper by Bradford B. Smith, of the Cleveland Trust Company, on the preparation of a Forecast Index for Business, based on a study of the movements of the long and short term rates of interest, deserves special mention as showing that it is as true in the U.S.A. as in this country that relative changes in the short and long term rates of interest still provide the best warning of the onset of trade depression. But much more will have to be achieved than this if business forecasting is to become of real service to the business community.

R. G.

7.—*The Distribution of Consumable Goods.* By Dorothea Braithwaite and S. P. Dobbs. London: Routledge, 1932. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. xiii + 304 pp. 10s. 6d.

The sub-title of this book is "An economic study," and its interest to statistical workers lies in the fact that it describes in economic terms a field particularly in need of quantitative analysis, but one in which data are meagre and the selection of the technical methods of treatment for solving the problems involved has still to be undertaken. Little interest has so far been officially directed to the distribution of goods, and the statistical work already carried out has been chiefly under the auspices of producers. The collaboration of Mrs. Braithwaite, a pioneer in academic research into the general problems of marketing, and Mr. Dobbs, a statistician on the staff of a factory producing food-stuffs marketed largely within the United Kingdom, has resulted in a survey which, apart from the interest of its economic analyses, enables one to obtain a clearer idea than has hitherto been possible of the existing data, the lines on which statistical research may proceed and the type of problem to be solved.

At the outset the authors emphasize a problem which will probably prove to be of enduring interest and which is outstanding at present—the costs of distribution. The feasibility of reducing these costs so as to render the selling price remunerative both to producer and to distributor and at the same time justifiable to the consumer is of obvious importance at a time when purchasing power is diminishing, when many producers believe that the possibilities of further economies within the factory are relatively few, and when the consumer considers all expenditure carefully. That retailers themselves regard distributive costs as too high is evident from trade newspapers, with their recurrent attacks on the middleman; that the retail gross margin is capable of reduction is shown by the recent and

rapid growth of "cut-price" shops. What has been lacking is evidence of the actual costs incurred and an analysis of the services for which they form the payment. The Balfour report on "Further Factors in Industrial Efficiency" quoted figures of costs and margins based on so small a number of retailing units as to expose in a striking manner the lack of data in this respect. Chapter XIV of this book gives a list of "typical" margins and expenses of retail shops based on private investigations, principally those conducted by Mr. W. R. Dunlop and by the authors themselves. These relate to shops selling seven main divisions of goods only, and no estimate can be formed of how far they are applicable to the whole of each trade, or of how far they differ according to the class of customer, the different parts of the country or the size of shop. Doubtless other investigators have made somewhat similar enquiries, and from an article published in *The Drapers' Organiser* for August, 1932, it appears that individual firms in some sections of retail distributors are collaborating to analyse for their own benefit costs in their particular trade. Such isolated efforts, admirable in themselves, inevitably suffer in usefulness if there is no co-ordination to secure identity of definition, besides being wasteful in the degree to which they overlap.

If, as seems probable, the whole group of economic activities by which raw materials are transformed into satisfactions is passing from a phase in which individual unco-ordinated endeavour was the normal mode of action into one in which a greater degree of planning will relate supply to demand, knowledge of the channels which goods follow and of the part played by price, by persuasion and by other forces in determining the size and direction of demand, as well as knowledge of the expenses incurred at each stage of production and distribution will evidently be necessary. This book gives an excellent account of the functions of the wholesaler, retailer, and advertiser. Its most controversial chapter is probably VII, which deals with advertising. While many will agree that the wastes in this activity are enormous, opinion will differ as to the precise point at which advertising ceases to give necessary information and passes on to create a reputation-value which has no real equivalent in consumer satisfaction. But, again, the impression left by this chapter, as by the others, is of the need for the collection and co-ordination of facts. The authors emphasise that we know neither what proportion of price is attributable to advertising nor what is the total sum expended annually. Similarly, we do not know (though we have estimates) how many outlets exist for any given type of article; if there are too many or too few wholesalers; if stocks are habitually too large or too small; whether the financing of stocks is economically or wastefully carried out. Apart from dairy products, for which the Ministry of Agriculture has published market reports, and motors, for which the Ministry of Transport issues monthly geographical analyses, there are few commodities for which we have any quantitative measure of consumption in different parts of the country. Knowledge of such differences is at present based on small samples taken by private enterprise, and is confined to those individuals and concerns who engage in market

research. Not every product lends itself as does the motor-car to an official national survey (which even gives monthly unit sales for each London borough), but there are many articles for which information could be obtained for the main divisions of the country by a single central bureau, or by one for each industry. Much sound individual statistical research is being carried on (frequently in disheartening conditions), while such events as the appointment of a committee of the International Chamber of Commerce to study distribution problems indicate that joint effort is likely in the near future. There is, however, a danger that the recent vogue for market research has in some cases led to worthless surveys; not every investigation is carried out by workers as well qualified as Mrs. Braithwaite and Mr. Dobbs. Their book has given us the first reasonably complete economic study of the distributive field. That service will be increased if the book leads statisticians to consider the ways in which the necessary data could best be secured for a statistical study of the same field in order to give producers and distributors an agreed basis for eliminating waste and increasing efficiency. I. D.

8.--*World Agriculture: An International Survey*. Royal Institute of International Affairs. Oxford University Press, 1932. 9½" × 6¼". 314 pp. 12s. 6d.

This publication, which has been prepared by a group of members of the Royal Institute of International Affairs, under the chairmanship of Viscount Astor, aims at providing, "for the general reader rather than the expert," a survey of the chief factors in the present international depression in agriculture. The field covered is immense, and great credit is due to the authors for the skill with which all the most relevant aspects of the problem are brought into view. A brief description of the contents will give an indication of the line of approach.

In the first part of the book, an examination is made of the position as regards production, consumption and trade in agricultural products, the influence of new methods of agriculture, especially the mechanization of farming operations, and the general aspects of the fall in prices. Here it is remarked that "under the existing state of affairs there are so many restrictions imposed by producers' organizations and by Governmental interference that the normal function of price in equating supply and demand is only operative within certain limits."

An interesting section is devoted to a description of the conditions of agriculture in different parts of the world, which provides as it were a key to differences in the policies pursued. This contrasts the outlook of countries in the New World which seek to economize labour by modern machinery with European countries which seek not so much to economize labour as to maintain a large rural population. Further differences are provided by Asiatic countries where the pressure of population on the land is the dominant problem, and again by tropical and semi-tropical countries. So long as the general level of prices was reasonably stable, these varying national conditions could be adjusted on customary lines, but the breakdown in prices

has led practically all countries to take measures prompted by motives of self-preservation, regardless of the consequences to others. It is to a study of these various devices that the third part of the Survey is devoted. This leads to the conclusion that "neither effective measures of valorization and marketing, national or international, nor the various measures of protection undertaken by single national units nor by groups of units, nor a combination of the two, can of themselves provide a remedy for the world depression in agriculture." The fortunes of agriculture, in short, are intimately bound up with the industrial and commercial activities of the rest of the world, and "the instability from which agriculture now suffers is part and parcel of the *malaise* affecting the economic systems of all civilised countries." The authors of the Survey look to the Economic Conference "to provide an opportunity for constructive action which will further the cause of world recovery and enable farmers of the world to extricate themselves from their present plight."

An appendix contains extracts from contributions sent in by various authorities to whom the first draft of the Report was submitted. These give some interesting personal opinions, which are not always in agreement with those expressed in the Report itself.

R. J. T.

9.—*The Corn Laws and Social England*. By C. R. Fay, Reader in Economic History in the University of Cambridge. Cambridge: University Press, 1932. 9" \times 5½". x + 223 pp. 10s. 6d.

After 1660, says Mr. Fay, "England became at once a great producer and consumer of wheat." On several earlier occasions the exportation of wheat had been forbidden when the home price reached a specified level, which was raised successively with the rising price of wheat, and an Act of that year, besides allowing the export of wheat at prices not exceeding 40s. per quarter, imposed for the first time in that century import duties of 4d. per quarter when the price was over 44s. and of 2s. when it was 44s. or less. In 1670 these rates were raised and varied at three price levels, the highest being 80s. when the duty was lowest. The next important Acts were that of 1689 granting a bounty on the export of wheat of 5s. when the home price was 48s. or less per quarter, and the Act of 1773 imposing four import rates, the highest of 22s. on wheat not exceeding 44s. per quarter, and the lowest of 1s. 4d. when the price was over 80s., prohibiting export when the home price was at or over 44s., and granting a bounty on export under 44s. Omitting the amending Acts of 1791 and 1804 and the special arrangements for feeding the nation during the war years, this combination of bounty on export and taxation of imports characterized British policy up till 1815. "From 1670 to 1804 the purpose of the corn laws," says Mr. Fay, quoting the well-known pamphlet of Charles Smith, "was unchanged. It was the dual one of preventing 'grain from being at any time either so dear that the poor cannot subsist or so cheap that the farmer cannot live by growing of it.'" The bounty was defended because it had promoted the extension of tillage and led to lower prices, but Adam Smith

condemned it as necessarily a factor tending to maintain prices, the actual fall that took place being due to the rise in the value of silver, and Mr. Fay conclusively supports him against the recent criticisms of Mr. Lipson and Mr. Barnes.

Up till 1765 Great Britain had normally an export surplus, but the period in which England "launched the industrial revolution, say 1765-75, was also the decade in which she began to lean seriously, though as yet intermittently, upon foreign countries for a portion of her wheat supply. . . . It is estimated that the population of England and Wales rose from 6.2 millions in 1750 to 9.1 in 1801. Therefore, despite the notable improvements in English agriculture, the home demand tended always and increasingly to outrun the home supply," and the export bounty died a natural death. In 1815 an Act was passed prohibiting imports when the price of wheat was below 80s. and admitting them when it was at or over 80s., a Committee of the House of Commons reporting that that was the lowest price remunerative to the farmer. Good harvests and improved agriculture kept prices generally below 80s., and the alternate opening and closing of the ports caused great fluctuations in prices, and Huskisson was thus gradually being converted to free trade. The first sliding scale was passed in 1828, but its gradations were such that whereas it was to the interest of the community that imports should begin at once in a time of scarcity, it paid the importer to withhold supplies until the duty was nominal, when he benefited also from the higher price. Peel passed an improved sliding scale in 1842, but the competing merits of a scale and a single duty were submerged in the clamour of the Anti-Corn Law League for complete abolition. The subsequent story is well known.

"In the period from 1815 to 1846," says Mr. Fay, "the corn laws had a material influence on prices: but how far, if at all, they raised prices it is impossible, even approximately, to determine. . . . Under the law of 1815 no duty was paid at all, and it is impossible to calculate the indirect effects of a non-existent tax. The calculation was no easier with the sliding scale introduced by the Act of 1828, for most of the corn was held up until the duty was nominal." In some years harvests were so abundant that the country could feed itself without imports; in other years of scarcity there were also short harvests on the Continent. The great bogey of the English farmer was Poland, whose sole market was England, and whose bonded wheat kept piling up ready to pour forth at any price when the ports were opened. After repeal the Californian gold discoveries and war in the United States kept up prices and saved the British farmer for a time. For this reason it has been said that repeal was a failure, but "free trade in wheat does not create cheap bread; it merely prevents an artificial rise in the price of the raw material of bread."

Space has not allowed reference to the interesting discussions of the changing position of the bakers, millers, and corn merchants, of weights, measures, and the machinery of ascertaining average prices. The book is clear and succinct, with no unnecessary detail

and no display of partisanship. As its author claims, it is appropriate that this ancient history should be studied again to-day, and he suspects that "the quota" may prove complex and cumbersome. But he adds: "It would, however, be idle to pretend that the food problem of 1932 closely resembles that of 1842. We are not near to famine. Our need is an increase of industry and trade, which will bring an increase of employment. And if this can be assured by imperial reciprocity, we are rich enough to pay the tax it may involve." A special word of praise must be given to the chapter on Huskisson, the first imperial economic statesman, and the early preferences. Everyone, whatever his views, will relish the last joyous chapter on "the corn laws and social thought," surveying with many a shrewd and ironic comment opinions from Adam Smith to Henry George. The book closes with two speeches by Peel, one defending the corn laws in 1842, the other proposing their abolition in 1846.

H. W. M.

10.—*Agricultural Russia and the Wheat Problem.* By Vladimir P. Timoshenko. Grain Economics Series, No. 1, Sept. 1932. Food Research Institute, Stanford University, California. 8 $\frac{1}{4}$ " \times 5 $\frac{1}{4}$ ". 571 pp. \$4.

This, the first of a new series of publications from the Stanford Research Institute, represents the result of an exhaustive and detailed investigation into the present and pre-war conditions of Russian agriculture, particularly as regards its prospective contribution to the world's wheat supply. Under the rapidly changing circumstances of the present time, opinions as to Russia's agricultural future can hardly fail to be highly speculative, but the author's deductions from the statistical and other evidence are certainly suggestive. He points out that the population of the U.S.S.R. in 1932 was estimated to be about 20 per cent. greater than in 1913 and to be growing at the rate of 2 per cent. annually. The area under bread grains, on the other hand, was only on the 1913 level. To bring production up to the pre-war *capita* level (*i.e.* sufficient to allow of consumption and export on the old basis), an immediate increase of about one-fifth would be required and a further gradual increment equal to the annual growth in the population. This is the fundamental problem which, according to Dr. Timoshenko's view, is not likely to be easily solved. Unoccupied free land is now only to be found in the Asiatic parts of the U.S.S.R.; much of it is of low quality as to climate or soil and is remote from market outlets. Reliable estimates of possible expansion in this direction are, however, lacking. A practical possibility, and one to which the Soviet authorities attach great importance, is an increase in the average yield of grain per acre. But improvement in this way is bound to be slow and there was apparently no sign of change during the first Five Year Plan. Even if an increase of 2 per cent. per annum could be obtained sufficient to cover the needs of the growing population, there would still remain the problem of raising the grain area by 20 per cent. Unless this is achieved, the permanent recovery of grain exports to the pre-war level can hardly be anticipated, though this does

not preclude substantial exports of wheat in years when the yield is materially above the average. This is a brief summary of the general conclusion reached by the author, but the book contains a vast amount of information, based chiefly on official data, carefully and critically brought together. A useful feature is an attempt to determine how far statistics from different sources and for different periods are properly comparable.

R. J. T.

11. *-Animal Industry in the British Empire.* By A. N. Duckham, M.A. Foreword by J. B. Orr, D.Sc., F.R.S. Oxford University Press; London: H. Milford, 1932. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. xiv + 239 pp. 15s.

The potential output of Empire agriculture was never so important a question as it is now. In this book, Mr. Duckham has provided facts which will serve as a valuable basis for discussion of the problem with regard to live-stock. The first chapter gives a preliminary survey of the situation, and in succeeding chapters the live-stock problems of each of the Dominions are reviewed.

The author stresses the difficulties of the organization of milk marketing in the British Isles, and somewhat anticipated the Report of the Milk Reorganization Commission in regarding the economic disposal of "surplus" milk as the key to the situation. Efficient production and distribution would pave the way for a considerable expansion of the dairying industry in the British Isles. The British live-stock farmer has to compete with Argentine beef and Danish dairy produce. By eradicating inferior stock and increasing supplies of cheap good quality grass and hay, the problem can be largely solved. If inefficient, our methods of live-stock marketing are picturesque and not entirely unsatisfactory. With an adequate system of marketing intelligence the blind movements of animals, the smaller markets, and operators who perform "no essential function" would disappear. The reviewer, however, suggests that this result depends on the use made of the market intelligence rather than the mere existence of the service, and it is doubtful if such happy reforms would readily ensue with even a perfect marketing intelligence service. The vision of the average British farmer eagerly scanning the weekly intelligence is pleasant but unlikely. We have not space to indicate the merits of the purely economic sections of the chapters devoted to the British Isles, and the economic aspects of potential output in each of the Dominions is equally well discussed in subsequent chapters. Attention is also given to the technical considerations of agricultural production.

Generally speaking, the British Isles and New Zealand could increase their output considerably; the possibilities of expansion in Canada, Australia and South Africa are, naturally, much greater. Imperial self-sufficiency is most probable in mutton and lamb. Cheese and butter, pigmeat and eggs follow, and lastly beef. In animal raw materials—wool, hides and skins—the Empire is at present more than self-sufficing.

This book is extremely valuable, in that it marshals the data which hitherto has had to be gathered from a variety of sources. Even though it is not exhaustive—and obviously no book could be

on this question—those who work on the subject now have available plenty of data and an excellent series of references. R. F. G.

12.—*American Population before the Federal Census of 1790.* By Evarts B. Greene and Virginia D. Harrington. New York: Columbia University Press, 1932. (London: Oxford University Press.) 9" × 6". xxiii + 228 pp. 23s. 6d.

This book was prepared under the auspices of the Columbia University Council for Research in the Social Sciences by the De Witt Clinton Professor of American History, Columbia University, and one of his research students. It includes estimates of the population of the thirteen colonies at thirty-one dates and separate estimates at all known dates for New England, the several States, and a variety of localities. Two earlier compilations were made by F. B. Dexter in 1887 and by W. A. Rossiter in 1909, but much additional matter has been made available since. The authors say that "the plan of the present work is to assemble in a single volume: (1) the data contained in the earlier compilations; (2) the new material scattered through a large number of publications, official and unofficial; (3) some additional data drawn from manuscript collections. . . . The statistics here presented obviously vary considerably in value, ranging from mere estimates of more or less informed contemporaries to the official estimates of Governments." The authors have not attempted to interpret their data, but have contented themselves with presenting the material (with specific references to the sources of the several items) for valuation by the student. The book is thus a very painstaking collection of raw material of a varied description—numbers of taxable persons, males liable to military service, number of houses, estimates of total population. The bibliography alone occupies twelve pages. Some of the estimates are of interest: 1,980 colonists in 1625; 200,000 in 1663 and also in 1688; 250,000 in 1700; 375,750 whites in 1715; 1,040,000 whites and 220,000 negroes in 1750; 2,240,000 inhabitants in 1765; and 2,776,000 in 1787. Many of the estimates are not harmonious with each other and are obviously more or less instructed guesses. The average size of a family is taken as 5.7 to 6 persons; at the census of 1790 it was 5.7. The militia is estimated at 5 to 1, and there seems to have been at least 7 persons (often more than one family) to a house. H. W. M.

13.—*American Business Leaders.* A Study in social origins and social stratification. By F. W. Taussig, Henry Lee Professor of Economics, and C. S. Joslyn, Instructor in Sociology, Harvard University. New York and London: Macmillan, 1932. 8½" × 5½". xiv + 319 pp. 18s.

The story of the boy who reaches New York with only one dime and a memory of his mother, and leaves it with a few million dollars and no false sentiment, is always a romantic and inspiring one. But this unromantic and laborious investigation will have none of it; "the outstanding fact brought to light by our data on occupational origins is that, contrary to an American tradition of long

standing, the typical figure among present-day business leaders in the United States is neither the son of a farmer nor the son of a wage-earner." In fact the present generation of American business leaders has been recruited in greater part from the sons of business men, and to the extent of nearly one-third from the sons of "big" business men. To some this may be a hard thought, but there is no escape from the hard facts of a questionnaire sent to some fifteen thousand "leading executives, partners, and owners of many of the largest manufacturing concerns, commercial banks, investment banking houses, railroads, public utility companies, newspapers, insurance companies, department stores, and chain store organizations in the United States," and to which, somewhat surprisingly, nearly sixty per cent. replied. On the other hand, one can take comfort in the conclusion that "lack of native ability rather than lack of opportunity is primarily responsible for the failure of the lower occupational classes to be as well represented as the higher classes" amongst business leaders. The bright boy of the Middle West can still defeat the nepotism of Chicago.

This book gives a very careful and detailed, but somewhat dull, account of an investigation that economists and sociologists may find interesting.

A. B. H.

14. *Other New Publications.**

Barriol (Alfred). *Théorie et Pratique des Opérations Financières*. 4e. ed. Paris: G. Doin et Cie., 1931. 7" × 4½"; viii + 429 pp.

[The second and third editions of M. Barriol's book were noticed in the *Journal* in 1915 and 1925 respectively. The present edition has been enlarged and generally brought up to date in accordance with the numerous changes in French fiscal legislation which have occurred since 1924. As before, the book is in three divisions, and includes a bibliography and index in addition to the detailed table of contents.]

Bhattacharyya (N. C.), and *Natesan (L. A.)*. (edited by). *Some Bengal Villages: an economic survey*. With a foreword by Sir Daniel Hamilton, Kt. University of Calcutta, 1932. 9½" × 6"; 225 pp.

[All planning for the improvement of economic conditions in India is obstructed by the want of precise information and, since between 70 and 80 per cent. of the people are directly dependent upon agriculture, the essential information is that relating to rural conditions. Valuable work in this field has lately been done in certain localities, notably by the Board of Economic Enquiry of the Punjab and the Bombay Labour Office; but their investigations only cover a fraction of the territory. Professor Bhattacharyya urges the organising of detailed village surveys by Indian universities, with the double end in view of accumulating accurate data for a comprehensive survey of the whole of Indian economy at some future date and of bringing Indian economic students face to face with the real problems of their national life. In the introductory chapter of this book Professor Bhattacharyya discusses the need for thorough investigation and the methods by which it could and should be done, and reviews the contributions so far made to the study of rural life; in the next, Professor Natesan gives a very interesting

* See also "Additions to Library," pp. 365 *et seq.*

account of the economic problems of rural Bengal, for which province, as Professor Bhattacharyya states, only very scanty information is as yet available, and a general sketch of the conditions which create them. These two essays form the introduction to local surveys of seven Bengal villages, and a different worker is responsible for each. The details lend support to the view expressed by Sir Daniel Hamilton in his foreword, that the Indian masses are indeed "one great depressed class," and that the moneylender is at the root of all the evil. Sir Daniel looks on the rural problem as largely psychological and, where Bengal is concerned, to the Co-operative Department of the Government to provide credit and with it hope.]

Colcord (Joanna C.). Emergency Work Relief, as carried out in twenty-six American Communities, 1930-31, with suggestions for setting up a program. New York: Russell Sage Foundation, 1932. $8\frac{3}{4}'' \times 5\frac{3}{4}''$; 286 pp. \$1.50.

[This book is the result of an enquiry undertaken by the Russell Sage Foundation in response to a request from President Hoover's "Organization on Unemployment Relief." The author, who is the director of the Foundation's Charity Organization Department, was assisted by Mr. W. C. Koplovitz and Mr. Russell H. Kurtz. A sketch of the development of work schemes for the unemployed and their general features precedes the twenty-six reports of schemes actually being carried out in towns of the middle, eastern, and southern states of the Union. The information gives details of the administrative machinery, financing, numbers employed, and period of employment, wage-rates and earnings (in cash or kind), health and accident provision, and the nature and amount of the work done. In some communities the work was organised by public officials, in some by committees of citizens, and in some by a combination of the two, and the methods adopted varied considerably. The emergency was, in fact, so sudden and so great that in many places the work was begun without sufficient preparation and it was to afford guidance for the future that this enquiry was made. The third part of the book on "a Program of Work Relief," reviews the essential requirements of such undertakings and discusses the working details. Specimens of the printed forms in use are provided in an appendix.]

McBain (A. G.). Complete Practical Income Tax. 6th ed. London: Gee & Co., 1932. $8\frac{1}{2}'' \times 5\frac{1}{2}''$; ix + 295 pp. 7s. 6d.

[This book was first published in 1925. In each of the following three years and again in 1930 it was revised in accordance with the most recent case law, Board of Inland Revenue concessions, and finance acts. The present edition has been brought up to date in the same way and includes the provisions of the Finance Act of 1932.]

Milbank Memorial Fund. Collected Papers, 1931. Division of Research. $9'' \times 5\frac{1}{2}''$.

[The papers brought together in this volume appeared originally in the Milbank Memorial Fund Quarterly Bulletin, the American Review of Tuberculosis, the American Journal of Hygiene, the American Journal of Public Health, and other journals. The first is the Annual Report for 1930 of the Division of Research of the Milbank Memorial Fund. The remainder are divided into four groups: Studies in the Diseases of Adult Life, Public Administration, Population, and Epidemiology and Vital Statistics. In the first section, Rollo H. Britten, Senior Statistician of the Office of Industrial Hygiene and Sanitation, contributes two papers dealing respectively with occupational and sex differences in respect to physical impairments. The second section is concerned with tuberculosis administration, public health nursing services, and

maternity services, in rural districts. The four papers in Section 3 (three are by Frank W. Notestein) deal respectively with Social Classes and the Birth Rate, Differential Fertility according to Geographical Areas, the Decrease in Sizes of Families from 1890 to 1910, and Differential Age at Marriage according to Social Class. With the exception of a paper by Edgar Sydenstricker on Age Incidence of Communicable Diseases, the last section is devoted entirely to tuberculosis; the subjects of the papers being the accuracy of official tuberculosis death rates, tuberculosis infection, and tuberculin testing.]

Rosset (Edouard). *Les lois démographiques de la guerre*. Roma : Istituto Poligrafico dello Stato, Libreria, 1932. $9\frac{3}{4}'' \times 6\frac{3}{4}''$; 45 pp.

[This study, by the Director of the Statistical Bureau of Lodz, Poland, was undertaken in order to establish the degree of consistency shown in the effects of war on the movement of population, and is published by the Italian Committee of the International Organisation for the Study of Population Problems. M. Rosset gives the number and rates of marriages, births, and civilian deaths for Belgium, Germany, France, Italy, and Hungary over a period beginning some years before the war and ending in 1926. Each country shows a sudden large drop in the marriage and birth rates and a considerable rise in the death rate in the first war year, an intensification of these tendencies during hostilities, a vigorous reversal immediately after the war, and, by 1926, a gradual return to approximately the pre-war levels and to a continuation of the pre-war trends. The figures for three neutral countries (Switzerland, Holland, and Sweden) show movements in the same directions though very much slighter in degree, and the population movements of France and Germany at the time of the Franco-Prussian War are found to give corresponding results. The author concludes that all the phenomena occur with such regularity that they may be regarded as the "demographical laws of war." The movements in each country and the comparison of each in different countries are very clearly shown in a series of graphs.]

Sanders (S. A.). *The Economic Welfare of the Maritime Provinces*. Economic Publications, No. 1. Wolfville, Nova Scotia, 1932. $9'' \times 5\frac{1}{2}''$; 160 pp.

[This essay won the prize in a competition conducted by Acadia University and, according to the judges, is "by far the most comprehensive study of economic conditions in the Maritimes that has yet been made." The Maritime Provinces have not kept pace with the prosperity and development enjoyed by other parts of the Dominion since the Confederation. The author examines the reasons for this. One would seem to be the migration from rural communities to the towns, which has meant migration from the Maritimes, and another the seasonal nature of the Maritime industries. The main branches of industry are discussed "with a view to discover the basic problems," and proposals are submitted for the provision of "machinery which will assist to overcome some of the handicaps for which there does not appear to be any specific remedy, and for the examination of problems which it has not been possible thoroughly to investigate."]

CURRENT NOTES.

We give below our usual table summarizing the overseas trade of the United Kingdom for the years ended February, 1932 and 1933. For the year 1932 the excess of imports over exports of merchandise amounted to £287 million; for the twelve months ended February, 1933, this excess was reduced to £264 million. This improvement in the adverse balance is due partly to the somewhat heavy forestalling in February, 1932, of the duties which came into force at the commencement of the following month, and partly to the relatively small excess of imports over exports of merchandise in both January (£20·7 million) and February (£16·7 million) of this year. The figure of £264 million for the latest period of twelve months is perhaps rather flattering in that it includes the months of April and May last, when imports were abnormally low. The smaller excess of imports over exports for the first two months of this year is due to a reduction in imports and not to any increase in exports, the very low figure for February being due in part to the smaller number of working days in the month.

Total imports amounted in value to £54,124,000 during January and to £49,077,000 during February, as compared with an average of £58·6 million during 1932. January and February together normally represent some 17 per cent. of the total imports of the year, whereas for January and February, 1933, the value of the imports was about 15 per cent. of the total for last year, after making a rough allowance for price changes, indicating, therefore, a relative fall in imports during the first two months of this year. Re-exports during the two months were valued at £8,640,000, being £2,052,000 less than in the corresponding months of 1932. This decrease was largely offset by an increase from £2,887,000 to £4,113,000 in the value of goods transhipped under bond, which are not included among the recorded imports and re-exports.

The value of retained imports of food, drink, and tobacco in the two months was £50·6 million, being smaller by £10·9 million than a year earlier, notwithstanding an increase of over £500,000 (50 per cent.) in respect of tobacco. Imports of unmanufactured tobacco from foreign countries continued to decline, while those from Empire sources increased, but the increase in value was mainly due to an increase in average value from 10½*d.* to 1*s.* 2½*d.* per lb., the total

quantity imported showing little change. Imports of wheat were much larger than in January and February, 1932, imports from Canada being nearly double those of a year ago and representing 58 per cent. of the total, while imports of wheat flour declined. Imports of bacon and eggs were substantially less than a year ago, and there were also considerable declines in the retained imports of beef, sugar, and tea.

Retained imports of raw materials were less than in January and February, 1932, by £4·5 million (16 per cent.). The reduction was due partly to a marked increase in the re-exports of raw wool to France and Belgium, the value of such re-exports increasing from £1,130,000 to £1,882,000. Substantial reductions were recorded in the retained imports of copper ore, tin ore, sawn hardwood, jute, and both chemical and mechanical wood pulp.

The reduction of about one-third in the value of retained imports of manufactured articles was due to the relatively high value of the imports in February, 1932, in anticipation of the new duties. Compared with the monthly average for March-December, 1932, imports of manufactured articles in the last two months showed an average reduction in value of 11 per cent. The following comparisons are made on the same basis. Imports of iron and steel were 38 per cent. smaller in tonnage than last year and the tonnage of the machinery imported declined by 20 per cent. The value of the imports of non-ferrous metals declined by 19 per cent. and that of textile manufactures by 15 per cent.; paper, cardboard, etc., and miscellaneous manufactured articles each showed a reduction in value of 12 per cent.; imports of apparel declined in value by 9 per cent., and of chemicals, drugs, etc., by 5 per cent.; there was a reduction of 1 per cent. in respect of the manufactured oils group and an increase of 3 per cent. in the leather group.

British exports during January and February were valued at £29·2 million and £27·9 million, respectively, the relative decline in February being due to the shorter working month, which might be expected to lead to a decline of about 8 per cent., whereas the actual reduction was only 4 per cent. The aggregate for the two months shows a reduction of £4·0 million (6·6 per cent.) compared with a year earlier. There was a decline of £842,000 (15 per cent.) in exports of food, drink, and tobacco, the decline affecting most of the principal items, but being specially marked in respect of grain and flour and of feeding stuffs for animals, due to the falling off in exports to the Irish Free State. Exports of coal were 404,000 tons (6 per cent.) less than in January and February, 1932. Increases exceeding

Movements and Classes.	Twelve Months ended February, 1932.	Twelve Months ended February, 1933.	Increase (+) or Decrease (—).			
Imports, o.i.f.—	£'000.	£'000.	£'000.			
Food, drink, and tobacco	415,406	362,053	(—) 53,353			
Raw materials and articles mainly un- manufactured	174,225	160,287	(—) 13,938			
Articles wholly or mainly manufac- tured	255,175	146,243	(—) 108,932			
Other articles	9,528	5,196	(—) 4,332			
Total Imports ..	854,334	673,779	(—) 180,555			
Exports, f.o.b.—						
<i>United Kingdom Produce and Manufactures—</i>						
Food, drink, and tobacco	34,631	31,487	(—) 3,144			
Raw materials and articles mainly un- manufactured	46,653	43,622	(—) 3,031			
Articles wholly or mainly manufac- tured	285,313	273,099	(—) 12,214			
Other articles	15,802	12,926	(—) 2,876			
<i>Imported Merchandise—</i>						
Food, drink, and tobacco	19,958	13,593	(—) 6,365			
Raw materials and articles mainly un- manufactured	25,401	23,960	(—) 1,441			
Articles wholly or mainly manufac- tured	16,721	10,997	(—) 5,724			
Other articles	589	311	(—) 278			
Total Exports ...	445,068	409,995	(—) 35,073			
Bullion and Specie—						
Imports	126,102	147,523	(+) 21,421			
Exports	155,539	129,099	(+) 26,440			
Movements of Shipping in the Foreign Trade—	Number of Vessels.	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.
<i>Entered with cargoes—</i>						
British	29,260	38,327	23,970	34,897	(—) 5,290	(—) 3,430
Foreign	26,326	22,727	21,901	20,310	(—) 4,425	(—) 2,417
Total entered ...	55,586	61,054	45,871	55,207	(—) 9,715	(—) 5,847
<i>Cleared with cargoes—</i>						
British	35,435	37,927	31,461	34,391	(—) 3,974	(—) 3,536
Foreign	19,668	20,394	18,829	18,586	(—) 839	(—) 1,808
Total cleared ...	55,103	58,321	50,290	52,977	(—) 4,813	(—) 5,344

100,000 tons were recorded in exports to France and Denmark, and decreases exceeding that figure in exports to Germany, the Irish Free State, Brazil, and the Netherlands. The reduction of £246,000 in the value of the coal exported was practically offset by increases in the value of exports of other raw materials, the class as a whole showing a reduction in value of only £4,000. Manufactured articles were £2.5 million (5 per cent.) less than in the first two months of 1932.

There was a decline of about 8 per cent. in the tonnage of iron and steel exported, due mainly to reduced exports of pig iron and galvanized sheets, but exports of some classes, notably plates and sheets, not coated, and wrought tubes, were greater than in the first two months of either 1930 or 1931. Exports of machinery and of new ships and boats declined further, but there was a slight recovery in exports of locomotives, while the number of motor-cars exported was much greater than in previous years, exports during January constituting a record for any month.

Among textiles, there was a substantial decline in exports of cotton yarns, though the exports were greater than two years ago, but the increase in exports of cotton piece goods continued, exports amounting to 392 million square yards or 9 per cent. more than last year. This increase was due mainly to a continuance of the recovery in the Indian market, exports during the first two months of this year, 111 million square yards, being 31 million more than a year ago and 44 million more than in January and February, 1931. Exports to many markets, including Australia, South Africa, and West Africa, were also substantially higher than in either of the earlier years, but there was a marked decline from 54 million square yards in 1932 to 22 million this year in exports to China and Hong Kong. The quantity of wool tops exported continued to increase and there was also an increase in exports of woollen and worsted tissues, which had previously shown a declining tendency. Linen and jute piece goods showed a further small increase, but there was a decline in exports of artificial silk tissues.

Groups in which there was an appreciable increase in the value of exports as compared with the first two months of 1932, apart from vehicles for which some details have already been given, were non-ferrous metals—principally nickel and tin—cutlery, hardware, etc., and electrical goods and apparatus. Among other important commodities, there was a marked increase in exports of petroleum refined in this country, of leather and of newsprint, while there was a considerable decline in exports of several items of apparel, including boots and shoes, hats, and woollen stockings and hose.

During the first three months of the year the trend of wholesale prices, as measured by the Board of Trade index number has been in a downward direction and the level of prices for March 1933 was 3·3 per cent. below that for December 1932. The fall was greatest (5·3 per cent.) in the groups for articles of food, but all groups except iron and steel showed some decline between the two months. At December 1932 the index number for all articles stood at 84·5 (1930 = 100) as compared with 83·9, 82·8 and 81·7 for January, February and March 1933. General prices at the end of March 1933 were about 0·8 per cent. below the level of 19 September 1931 when the gold standard ceased to govern currency issues, food prices being 4·9 per cent. below and the prices of other articles being 1·6 per cent. above that level. Among the most notable changes in price were those for English mutton and New Zealand, the prices for the first qualities of each being about the same (74s. per cwt.) in December 1932 whereas in March the price for English mutton had advanced 23 per cent. and that for New Zealand lamb had fallen 23 per cent. Bacon prices over the same period had advanced perceptibly, those for first qualities of Irish bacon rising as much as 22 per cent. In March 1933 the average price of Indian tea at the London auctions was nearly 32 per cent. above that for December 1932. The fall in the prices of imported butters during the three months was considerable, about 16 per cent. for Danish and rather more than 10 per cent. for New Zealand. Over the last twelve months, however, the prices of New Zealand butters have fallen more than Danish prices.

The index numbers of wholesale prices, as calculated by the Board of Trade with the base years 1913, 1924, and 1930, are set out below for the last four months.

Base Year.	Month.	Food.	Not Food.	Total.
1930 = 100	Dec. 1932	85·1	84·3	84·5
	Jan. 1933	84·2	83·8	83·9
	Feb. 1933	82·5	83·0	82·8
	March 1933	80·6	82·4	81·7
1924 = 100	Dec. 1932	64·8	58·7	60·8
	Jan. 1933	64·1	58·4	60·3
	Feb. 1933	62·8	57·8	59·5
	March 1933	61·4	57·4	58·7
1913 = 100	Dec. 1932	107·7	97·3	101·0
	Jan. 1933	106·6	96·8	100·3
	Feb. 1933	104·5	95·8	98·9
	March 1933	102·1	95·2	97·6

The *Economist* index number (1927 = 100) which stood at 61.1 at 28 Dec. 1932 had fallen gradually to 59.3 at 5 April, 1933 on about 2.9 per cent., all groups including minerals showing some decline which was most pronounced (about 5.6 per cent.) in the case of textiles. As compared with the end of March 1932 the index number indicates a fall in general prices of about 9.2 per cent. (65.3 to 59.3).

The index number of general prices as calculated by the *Statist* shows somewhat less movement since the end of 1932, the fall indicated being from 77.7 to 77.0 (average of 1866-77 = 100) or rather less than 1 per cent. The considerable fall in cereals (7.0 per cent.) was balanced by increases in other food products (5.4 per cent. in animal foods and 6.2 per cent. in the sugar, tea and coffee group).

The trend of the British Index Numbers as compared with those of the United States, France and Germany is shown below.

	Board of Trade (1930 = 100).	<i>Economist</i> (1927 = 100).	<i>Statist</i> (1866-77 = 100).	U.S.A. (Brad- street) (1913 = 100).	France (<i>Stat. Gen.</i>) (1913 = 100).	Germany (<i>Stat. Reichsamt</i>) (1913 = 100).
August 1931 ...	83.3	62.3	79.1	92.2	455	110.2
December 1932 ...	84.5	61.1	77.7	73.7	390	91.0
March 1933 ...	81.7	59.6	77.0	69.0 *	385	91.2 *

* February 1933.

Since December 1932 there has been a continuous and fairly considerable decline in *shipping freights* amounting over the three months to nearly 10 per cent. According to the index number compiled by the Chamber of Shipping and published in the *Statist*, freights fell from 19.69 in December 1932 (1920 = 100) to 18.84 in January, 18.56 in February and 17.74 in March 1933. Over the whole year 1932 freights showed a decline of 5.7 per cent. as compared with 1931 and of nearly 25 per cent. compared with 1929.

From January to March 1933 there was on the whole a slight improvement in the monthly valuation of *Stock Exchange Securities* as measured by the *Bankers' Magazine* index number of values, the number rising from 109.4 (Dec. 1921 = 100) at the end of December 1932 to 111.2 in March 1933. The increase was almost entirely in the values of Fixed Interest Stocks which rose from 116.1 to 118.4, those for Variable Dividend Securities

showing only a fractional increase—95·8 to 96·2. The high values of British Government Securities and similar stocks still remain the distinguishing feature.

According to the Ministry of Labour index number of *retail* prices of articles of working-class consumption, food prices have declined continuously since the beginning of the year and at 1st April were only 15 per cent. above the level of July 1914. The principal articles showing decreases over the period were butter and eggs, and there was a slight increase in bacon prices. Compared with the beginning of April 1932 there was a fall of as much as 8·7 per cent. and as much as 10 per cent. with prices at the beginning of September 1931. There was no change recorded in the cost of rent, clothing, fuel and other miscellaneous articles of working-class consumption, the index numbers for which have remained constant since the beginning of 1933. Over the last twelve months indeed there has been little change in this connection except a slight fall in the prices of clothing and of fuel and a still slighter rise in rents.

The latest returns relating to *retail sales* prepared by the Incorporated Association of Retail Distributors and the Bank of England and published in the Board of Trade Journal show as usual falls in the value of business done but when the decline in prices is taken into consideration there is not disclosed any drop in the consumption either of food or other merchandise. The latest returns enable a comparison to be made between three twelve-monthly periods ending January in the years 1931, 1932 and 1933. As between the twelve months ended Jan. 1931 and that ended Jan. 1932, there was a decline of 4·9 per cent., and there was a decline of 4·1 per cent. between the twelve months ended Jan. 1932 and that which ended in January of this year. The decline in both periods was somewhat greater as regards articles of food than as regards other merchandise, food sales dropping 5·2 and 5·1 per cent., and sales of merchandise dropping 4·5 and 3·4 per cent. in the periods ended January 1932 and January 1933 respectively. Stocks at the end of January 1933 were 5·8 per cent. lower than a year ago, but the number of persons employed, although on the whole less than in 1931, does not indicate any appreciable increase in the amount of unemployment.

The following table gives for the principal countries the percentage increases, on July 1932, and on the latest available date

in the retail prices of food and other items compared with the prices at July 1914.

	Retail Prices of Food at		Retail Prices of All Items at		Date of Latest Return.
	July 1932.	Latest date available.	July 1932.	Latest date available.	
Great Britain	% 25	% 15	% 43	% 37	Apl. 1, 1933
<i>British Dominions, etc.</i>					
Australia	23	14	—	22 *	Feb. 1933
Canada	- 8	- 9	25	22	"
Irish Free State	34 †	35 †	53 †	51	"
New Zealand	8	3	31 †	27	"
South Africa	- 6	6	17	13	"
<i>Foreign Countries.</i>					
Belgium	—	—	608	622	Dec. "
Czechoslovakia	9	8	2	4	Dec. 1932
Denmark	15	15	54	55	Jan. 1933
Egypt (Cairo)	8	8	28	30	Dec. 1932
Finland	756	758	894	889	Feb. 1933
France (Paris)	443	427	417 ††	416 §	Mar. 1933
Germany	14	7	22	17	Feb. 1933
Holland	—	—	41 ||	40	Dec. 1932
Italy	318	312	—	265 ¶	Feb. 1932
Norway	34	30	49	47	Mar. 1933
Spain (Madrid)	79	77	—	—	Jan. 1933
Sweden	28	21	56	53 **	Mar. 1933
Switzerland	24	17	38	33	Feb. 1933
United States	1	- 5	36 ||	32 ††	Jan. 1933

* 2nd Quarter 1932. † August 1932. ‡ November 1932. § 4th Quarter 1932.
 || Figure for June 1932. ¶ July-December 1932.
 ** April 1933. †† December 1932. ‡‡ 3rd Oct. 1932.

Unemployment in Great Britain at March 20th, 1933 was somewhat greater than at the end of 1932, the numbers on the registers of the employment exchanges (2,776,184) showing an increase of nearly 53,000 as compared with December 19th, 1932. There was an increase also of nearly 209,000 as compared with the end of March 1932. The rate of unemployment in the insured trades which was 21.5 per cent. at the end of the year rose to 22.9 per cent. at the end of January, fell slightly to 22.6 per cent. in February, and to 21.9 per cent. at the end of March 1933. Some improvement of a seasonal nature is to be expected during the spring months, but the prospect of a marked increase in employment is not yet noticeable. There was some seasonal improvement during the three months in building, public works construction, and in the clothing and boot and shoe trades and some slight increase in employment in the iron and steel

and tinsplate trades and in the woollen industry. On the other hand, there was some slackening off in the cotton trade and in docks and harbour service. The numbers on the registers of employment exchanges for the last four months are set out below for Great Britain.

Date.	Persons normally in regular employment.		Persons normally in casual employment.	Total.
	Wholly unemployed.	Temporarily stopped.		
Dec. 19, 1932	2,171,175	454,522	97,590	2,723,287
Jan. 23, 1933	2,280,033	524,229	98,803	2,903,065
Feb. 20, "	2,241,168	512,587	102,883	2,856,638
Mar. 20, "	2,170,252	503,377	102,555	2,776,184
Mar. 21, 1932	2,042,444	422,676	102,212	2,567,332

Employment in Germany, according to the official reports summarised in the Ministry of Labour Gazette, continues very depressed although there has been some decline in the number unemployed since the end of January. At the end of March 5,768,910 persons were recorded as available for and seeking work, representing a drop of 152,500 compared with the end of December 1932. Of these 5,598,100 were reported as unemployed. Not quite 39 per cent. of the unemployed were in receipt of unemployment insurance benefit, whether standard or emergency pay, as since the beginning of 1932 there have been considerable restrictions in force limiting the conditions for the receipt of benefit. At the end of March 1933 only 686,400 were in receipt of standard benefit. The numbers receiving emergency benefit were about 1,480,000.

The rate of unemployment in German Trade Unions was higher during December 1932 and January and February 1933 than recorded at any previous time. Out of a total membership of slightly over three millions 45·1 per cent. were returned as unemployed at the end of 1932 and 46·2 per cent. and 47·4 per cent. at the end of January 1933 and February 1933 respectively. The number returned as on short time at the end of February was 24·1 per cent.

Employment in France shows very little change. There was a slight fall over the three months in the numbers on the registers of employment exchanges, but the numbers so registered are not a very satisfactory index of the state of employment. As a result of the special monthly investigation into the numbers employed and hours worked in mining, industrial transport, and commercial undertakings, employing at least 100 workers, it would appear that the

reduction in the numbers employed as compared with a year ago was 5·75 per cent. at the beginning of January, 4·18 per cent. at the beginning of February, and 3·2 per cent. at the beginning of March 1933. At no period since this special return was instituted have the figures shown an increase in the numbers employed. Of those employed at the beginning of March 20 per cent. were working 40 hours per week or less.

Statistics from the Approved Unemployment Insurance Societies in Belgium covering nearly a million members show that employment continued to decline up to the end of January 1933, the latest date available when the rate of unemployment was 22·1 per cent., or higher than at any recorded period. In addition 20·9 per cent. were intermittently employed, and these lost 24·8 per cent. of the aggregate possible working days.

In the Scandinavian countries unemployment increased during the three winter months of December, January, and February, and the rate of unemployment in trade unions was considerably greater than in the corresponding three months of 1931-2. In Denmark, Sweden, and Norway the percentages unemployed at the end of February 1933 were 42·8 per cent., 27·3 per cent. and 33·0 per cent. respectively.

In Italy unemployment continues to increase and was higher at the end of February 1933 than at any period during the last five years. The number recorded as unemployed by the National Social Insurance Fund at the end of February 1933 was 1,229,387 or nearly 3,000 more than at the end of January and nearly 100,000 more than at the end of December 1932. It was about 81,400 more than at the end of February 1932.

Employment in the United States continues to decline. According to the returns received by the Federal Bureau of Labour, covering four and a quarter million workpeople in about 70,000 establishments, the numbers employed have declined each month during the first quarter of 1933 and the earnings have also decreased. During March the earnings decreased 8·2 per cent. and the numbers employed 4·2 per cent. Apart from a slight improvement in August-October 1932, there has been a monthly decline both in earnings and numbers employed in almost every month since the autumn of 1929.

Employment in Canada has declined slightly since the latter half of 1932 and the index number of employment at the beginning of March 1933 had fallen to 76·9 (average of 1926 = 100). At December 1st, 1932, the number stood at 83·2, and at the beginning of March 1932, at 88·7, a fall of 13·3 per cent. during the twelve months. During the twelve months ended March 1st, 1932, there was a fall of

about 11.5 per cent. Neither in Great Britain nor abroad are there yet any appreciable signs of an improvement in employment.

We have received from the International Institute of Agriculture the second issue of the *Recueil de Statistique sur les données de la Comptabilité Agricole*, the first of which was noticed in the *Journal* for 1932 (p. 332). The present volume, which covers the year 1928-29, has been reduced in size by the omission of some of the more elaborate detail, notably in the first two tables, which analyse the distribution of land by crops and countries. This has resulted in speeding up the publication and making the volume more convenient to handle, without detracting from its value. Table 3 shows the capital used in agriculture and the gross return per hectare is recorded in the next table, which makes readily apparent the characteristic types of continental agriculture. The single farm in England for which records are given (as against 242 for Sweden and 474 for Finland!) shows that in 1928-29 51 per cent. of the gross return was derived from live-stock, 24 per cent. from crops and 25 per cent. from miscellaneous sources. Sweden relied on live-stock for over 75 per cent. of the gross income and Denmark for 90 per cent.; the figures for Germany were similar to those for England. The output intended for sale is expressed as a percentage of the total gross return in Table 5, the general notes of which could be more advantageously given at the beginning (on p. 101) instead of at the end (on p. 115). Costs of production per hectare are recorded in Table 6 and final results in Tables 7 and 8. The surprising discovery is made in the latter Tables that the farm selected for England is one of the very few which made a profit in 1928-29. Fruit-growing in Switzerland gave the best results and live-stock production in Switzerland the worst. Detailed analyses of distribution of land, of capital employed and of costs of production conclude this most informative publication.

Two further numbers of the Economic Series of the Ministry of Agriculture have appeared since mention of the Series was last made in these columns (Part IV, 1932, p. 755). These two recent publications are the Reports of the two Reorganization Commissions set up in respect of Pigs and Pig Products, and Milk. The Pig Reorganization Commission recommend the establishment of a Quota Advisory Committee which should be assisted by a Bacon Imports Advisory Committee. In addition three Boards are proposed to deal with Pig Marketing, Bacon Marketing and Development of the Pig Industry. Import duties are not recommended.

The task set the Reorganization Commission for Milk was stupendous and the Report is a notable publication. The complicated nature of the existing milk and dairy produce markets is well known. A Central Producers' Board and a Central Dairymen's and Manufacturers' Board (both with regional organization) and a Joint Milk Council are recommended. Apart from the valuable analyses and proposals contained in these two Reports, their statistical content is, to say the least, considerable.

There are few subjects on which it is more difficult to obtain reliable information than the condition of Soviet Russia. Most accounts are partial and biased, and it is, therefore, with some relief that we turn to the publications of the Birmingham Bureau of Research on Russian Economic Conditions, which is a part of the Russian Department of the University of Birmingham, for the Vice-Chancellor assures us that they are "a scientific contribution to the study of important problems." The Bureau is in charge of Professor Konovalov, the Head of the Russian Department in the University, and he is assisted by Mr. S. Turin of the University of London (School of Slavonic and East European Studies) and two members of the Russian Economic Service at Prague. Five Memoranda have been issued. The first (May, 1931) deals with "some results of the second year of the Five-Year Plan" and with "compulsory labour in the U.S.S.R." The second (July, 1931) deals with the foreign trade of the U.S.S.R., the third (November, 1931) with the national income of the U.S.S.R., the fourth (February, 1932) with the balance of payments and the foreign debt of the U.S.S.R., and the fifth (May, 1932) with the Five-Year Plan, agricultural collectivization, and oil consumption and export. All are sufficiently documented with statistics. It is interesting to observe that the number of persons engaged in large-scale production increased from 2,954,000 in 1913 to 4,777,000 and that the output per head was greater by nearly 52 per cent. in the latter year; 570,000 more workers were engaged than had been planned, and owing to defective training the output per head was 27 per cent. less than had been expected. For 1932 increases over 1931 of 14 per cent. in numbers and 21 per cent. in output were planned. The quality of goods, as shown by extracts from the Soviet press, declined by 30 per cent. during 1930 and 1931. The following quotation from the second Memorandum is instructive. "The peculiarities of the U.S.S.R. economic system enable the Soviet Government, *ceteris paribus*, to keep the prices of its exports at a much lower level than other countries can do. The Soviet trading organizations, generally speaking, like any other

exporters, are anxious to obtain the highest prices for their goods, but under the circumstances they must reconcile themselves to growing losses on export operations. Owing to the protective wall built by the monopoly of foreign trade, the level of prices in the world markets is, on the whole, a matter of indifference to the Soviets: all that the U.S.S.R. is interested in is that the prices on articles it imports should decline more rapidly than the prices on articles it exports. The result would be that, for the same quantity of goods exported, the U.S.S.R. would receive a greater quantity of imports. The practice of selling goods abroad below cost price, to obtain foreign currency and pay for the imports, has been resorted to frequently." We wish all success to the Birmingham Bureau for its enterprise, and note, for the benefit of those concerned, that it is willing to undertake research on "specialized subjects" for a fee.

The ninth annual issue of the *Bulletin du Bureau International de Statistique Commerciale* has reached us. The Bureau, it will be remembered, was set up as a result of the Brussels Conferences of 1910 and 1913, in order to collect, co-ordinate, and publish the special statistics of imports and exports drawn up under uniform numbered headings and grouped in a uniform manner agreed on at the Conferences and registered in the convention signed by twenty-five countries. Owing to the intervention of the War the first Bulletin only appeared in 1925 and contained statistics for 1922. The one before us gives the 1930 figures. Imports and exports are first given in summary form; the first four tables give the total value and weight of each of the five main groups of commodities imported and exported, by countries and by commodity groups. The tables which form the remainder of the volume give the figures (weight and value) of the separate commodities by countries, and for the countries by commodities. All the values are given in gold francs as well as in the national money of each country. It should be noted that the alphabetical lists of commodities given with their classification numbers at the beginning of the volume, in French, English, German, and Dutch, constitute a most useful quadrilingual dictionary of commodities. The Bureau hope in time to include other languages.

The first meeting of the Study Group this session was held in October, when the Chairman, Miss Iris Douglas, read a paper entitled "The Distributive Trades since 1920." In November Mr. Craft addressed the Group on "The Geneva Convention on Economic Statistics in relation to Foreign Trade." The annual joint meeting

with the Institute of Actuaries Students' Society took place in December in Staple Inn Hall. Mr. Palin Elderton took the Chair and Mr. Gordon, ex-Chairman of the Group, addressed a large meeting on "The Accurate Measurement of Price Changes." In January Mr. T. Clifton of the L.M.S. discussed "Some Aspects of Statistical Measurement of Railway Efficiency," and in February Mr. A. R. Lester presented a paper on "The Meat Supplies of the United Kingdom." All these meetings have been well attended, and the discussions are increasing in vigour and interest.

OBITUARY

ETHEL MAY NEWBOLD

ETHEL MAY NEWBOLD was born on August 28th, 1882 and died on March 25th, 1933. She was educated at Tunbridge Wells High School and Newnham College, Cambridge (of which she was an entrance scholar) and classed equal to the 26th wrangler in the Tripos of 1905. In later life, as a post graduate pupil in the Galton Laboratory, she proceeded M.Sc. in the University of London (1926) and was awarded the degree of D.Sc. in 1929.

After coming down from Cambridge Miss Newbold was for two years an assistant mistress at Godolphin School, Salisbury. Her initiation to statistics arose out of some war work in the Ministry of Munitions and from 1919 to 1929, she was wholly engaged in statistical investigation.

Miss Newbold was elected a fellow of the Royal Statistical Society in 1921 and awarded its Guy Medal in 1928 (the only woman who has yet received this distinction). She served on the Council during the sessions 1927-8, 1928-9 and 1929-30.

Most of Miss Newbold's work was done as a member of the staff of a committee appointed by the Medical Research Council in 1921 to co-ordinate and supervise medical and industrial statistical inquiries financed by the Council. It is a melancholy reflection that of the small committee and still smaller staff, no less than six have died within the last ten years, viz. Mr. Alfred Henry, Dr. John Brownlee, Dr. T. H. C. Stevenson, Miss E. C. C. Allen, Mr. H. E. Soper, and Miss E. M. Newbold. Three of them were in the prime of life and the eldest at an age when, in the normal course of events, many more years of fruitful investigation might have been expected. Miss Allen who was under 30 when she died, had given evidence of first rate ability; all the others had done work which is never likely to be forgotten by serious students.

Miss Newbold's statistical career covered little more than eight years; few investigators have done so much in so short a time. She was the author or part author of 17 papers and her share in joint work—as her most frequent collaborator I can speak with authority—was always large. It may be true that her diffidence—like Soper, she always under-estimated her own powers—often prevented her from suggesting a problem, but, when a research was in progress, she had plenty of original suggestions to make for its prosecution. Of our

little group at the National Institute of Medical Research she was, next to Soper, much the best mathematical statistician, and, I think, quite the best logical critic. The published work is by no means a complete record of what she did. Few people have so generously put their time at the disposal of others. Undoubtedly her paper in the *Journal* entitled "Practical Applications of Statistics of Repeated Events, particularly to Industrial Accidents," in respect of which the Guy Medal was awarded, is her most important contribution to statistical science.

In their 1920 paper (*J.R.S.S.* 1920, LXXXIII, 255-279), Greenwood and Yule discussed the theory of accident distributions, a preliminary statistical account of which had been published by Greenwood and Woods in the previous year (Reports of the Industrial Fatigue Research Board, No. 4, 1919). They found that the best description of the frequency distributions of 0, 1, 2, 3, etc. accidents per person in a series of groups of employees, was afforded by supposing that the a priori liability to sustain an accident varied continuously from a very low to a very high value. They found that, if it were supposed that the distribution of multiple accidents sustained by persons presenting a particular grade of susceptibility obeyed the Poisson law, and if the distribution in the population at risk of the Poisson parameter, λ were assumed to conform to the skew frequency system of Type III, an adequate description of the observed data was obtained. Miss Newbold not only greatly strengthened the observational basis of the conclusion that varying degrees of accident proneness are of fundamental importance in the aetiology of industrial accidents, but she also greatly improved the mathematical treatment of the subject. Greenwood and Yule's choice of a Type III curve was a lucky guess and in their treatment of the data they did not discuss the nature of the approximation involved in identifying the observed number of accidents in a sample with the Poisson parameter.

Miss Newbold noted that if one had a series of sample periods relating to the same N people, the number of accidents observed might be expected to behave in the same way as the results of taking samples of N in fixed proportions as regards the λ 's, from a set of Poisson distributions about different fixed means. This type of compound sampling had been discussed by Tschuprow, but, in his more general case, it was not usually possible to pass from the constants of the observations to those of the sub-means. But since a Poisson series is defined by a single constant, an approximate solution is possible, if the observed mean number of accidents for the whole group is taken as an estimate of the mean λ .

Miss Newbold by a skilful use of Tschuprow's methods, solved her problem and obtained the β 's of the λ distribution. Apart from the

considerable value of the results themselves, the work is a good introduction to the study of Tschuprow's method. Thanks to Dr. Isserlis and Miss Newbold, English students have no excuse for neglecting to understand his technique. If an accident distribution is determined by individual proneness, it follows that the accident scores of individuals observed over two periods should be correlated and the theoretical value of such correlation should be determinate. Miss Newbold obtained the theoretical value, on the assumption of N large, for different periods of observation and showed that the agreement between theoretical and observed values was satisfactory.

The literature of the accident problem continues to grow, but much of it is merely repetitive and nothing of statistical importance has been added to Miss Newbold's work which is likely to remain the standard paper from a statistical point of view. There is little need for further statistical verifications of the hypothesis of accident proneness; what is required and, of course, very difficult to secure, is a fool proof method of determining accident proneness *before* exposure to risk of accident.

The pages of a scientific journal are no doubt not the place in which to expatiate on the personal qualities of a friend and colleague. But I may be permitted to say, and all who knew her will agree it is no mere obituary rhetoric, that Ethel Newbold had a genius for friendship and all whom she honoured with her friendship will remember her generosity in word and deed. She never said, much less did, an unkind thing and has influenced for good the lives of all her colleagues and assistants.

M. G.

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- (1928) The Epidemic Potency of Strains of *Bact. Aertrycke* of varying virulence. A Report to the Medical Research Council (with M. GREENWOOD, W. W. C. TOPLEY and J. WILSON). *J. Hyg.* 27, No. 4. June.
- (1930) An Investigation into the Agglutinating Power of Human Sera for *Bacillus Typhosus* and various allied organisms (with M. M. SMITH and M. H. MACVIE). *J. Hyg.* 30, No. 1. April.
- (1930) A Further Study of Herd Mortality under Epidemic Conditions (with M. GREENWOOD and J. WILSON). *J. Hyg.* 30, No. 2. June.
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STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS.

UNITED KINGDOM—

Auctioneers' and Estate Agents' Institute of the United Kingdom, Journal—

*February, 1933—*Valuation under modern conditions: *J. G. Head.*

*March, 1933—*Spoiling England: *E. Guy Dawber.*

Bankers' Magazine—

*February, 1933—*The bank balance-sheets. World prices and the money question: *A. J. Liversedge.* The future of joint stock banking in Germany: *Erich Roll.*

*March, 1933—*The financial outlook (Bankers' views). The New Zealand Central Reserve Bank Bill: *C. B. Lockner.*

*April, 1933—*The American crisis—its effect upon the world situation. Problems facing the World Economic Conference: *A. H. Gibson.* The gold movements of 1932 (with charts): *A. J. Liversedge.*

*Eugenics Review, January, 1933—*Sir Bernard Mallet: two appreciations, by *Leonard Darwin* and *G. M. Chambers.* Evolution by selection: "*Student.*" Human fertility, II—a further study of German women: *W. Wagner-Manslau.*

*Biometrika, November, 1932—*Further applications in statistics of the $T_m(x)$ Bessel function: *Karl Pearson, S. A. Stouffer,* and *F. N. David.* Experimental discussion of the (χ^2, P) test for goodness of fit: *Karl Pearson.* The percentage limits for the distribution of range in samples from a normal population: *E. S. Pearson.* A note on the distribution of the correlation ratio: *John Wishart.* On the probability that two independent distributions of frequency are really samples from the same parent population: *Karl Pearson.* Certain generalizations in the analysis of variance: *S. S. Wilks.*

*East India Association, Journal, January, 1933—*Reforms in India and the depressed classes: *Prof. John Coatman.*

*Economic Journal, March, 1933—*Building societies—some economic aspects: *Sir Harold Bellman.* Taxation of co-operative dividend: *Prof. D. H. Macgregor.* The population problem in India: *Prof. G. F. Shirras.* The national income of the Irish Free State in 1926: *T. J. Kiernan.*

*Economica, February, 1933—*The study of economic history: *R. H. Tawney.* A letter on the true principles of advantageous exportation, 1818. A parable on savings and investment: *Joan Robinson.*

UNITED KINGDOM—Contd.

Institute of Actuaries, Journal, Part I, 1933—Presidential address of Mr. W. Palin Elderton. Review of the recent trend of mortality in England and Wales: P. G. Brown.

Institute of Bankers, Journal, February, 1933—Some financial theories in the light of recent experience, Lecture IV: Prof. J. H. Jones.

Lloyds Bank Monthly Review—

January, 1933—World recovery and war debts: H. A. L. Fisher.

February, 1933—The British railway problem: Norman Crump.

March, 1933—The problem of employment: Aylmer Vallance.

April, 1933—The ethics of capitalism: H. A. L. Fisher.

Midland Bank Monthly Review, January–February, 1933—Gold and sterling. The possibilities of reflation: Rt. Hon. R. McKenna.

Public Administration, January, 1933—The civil service under modern conditions of legislation and administration: Rt. Hon. Lord Eustace Percy. The efficiency of efficiency rating systems: Winifred Spielman Raphael.

Royal Society, Proceedings, Series A, Vol. 139, No. 838—Concepts of inverse probability and fiducial probability referring to unknown parameters: R. A. Fisher.

Royal Society of Arts, Journal, March, 1933—Recent tendencies of Indian trade: H. A. F. Lindsay.

Royal Society of Edinburgh, Proceedings, Session 1932–33, Part I.—A matrix notation for Mendelian populations: Prof. Lancelot Hogben.

Westminster Bank Review, March, 1933—Britain's balance of payments.

UNITED STATES—

Actuarial Society of America, Transactions, October, 1932—Parental history and longevity: Edward W. Marshall. Note on effect of family history on longevity: Arthur Hunter. The interpretation of mortality statistics: Edward W. Marshall. Effect of family history on longevity after age 45: Valentine Howell.

American Academy of Political and Social Science, Annals, March, 1933—Whole number on the International Labor Organization, being a survey by 21 experts of the work and the relations of one of the three permanent international agencies established under the Treaty of Versailles.

American Economic Review, March, 1933—American trade unionism and social insurance: George E. Barnett. Tariff legislation and international relations: Philip Wright. Faulty investment of corporate savings: Robert Weidenhammer. World's output of work: Thomas T. Read. Economics of saving: G. P. Watkins. "Fundamental error" in Keynes's treatise: B. P. Adarkar.

UNITED STATES—*Contd.*

American Supplement, March, 1933—Papers and proceedings of the Forty-fifth Annual Meeting of the American Economic Association, including: The rise of monopoly in the United States. The record of insurance during the depression. Reserves for unemployment insurance. Stabilization of industries: oil, cotton textile. Federal Reserve policy since 1926.

Harvard Business Review, January, 1933—The probable five-year future of steel: *R. E. Baker* and *H. R. Moorhouse*. The construction industry in the depression: attempts at stabilization: *Joseph B. Hubbard*. The cost of instalment buying: *Lewis A. Froman*.

Journal of Political Economy, February, 1933—The expansion of bank credit, I: *James W. Angell* and *Karel F. Ficek*. Treatment of credit in contemporary monetary theory: *Lauchlin Currie*. Frisch on the measurement of utility: *Henry Schultz*. An unpublished letter of Ricardo to Malthus: *Jacob Viner*.

Milbank Memorial Fund Quarterly Bulletin, January, 1933—Preliminary notes on a co-operative investigation of family limitation: *Raymond Pearl*.

Monthly Labor Review—

December, 1932—Unemployment-benefit plans in the United States, 1931 and 1932. Part I. Company and joint agreement plans.

January, 1933—Unemployment-benefit plans in the United States during 1931 and 1932. Unemployment insurance in the United States and in foreign countries.

February, 1933—Employment in relation to mechanization in the bituminous-coal industry. Findings of President's Research Committee on Social Trends.

Quarterly Journal of Economics, February, 1933—Theoretical remarks on price policy, Hotelling's case with variations: *F. Zeuthen*. The process of industrial concentration: *A. R. Burns*. Unemployment reserves: some questions of principle: *R. S. Meriam*.

Record, November, 1932—Annual dividends—an asset-share method of distribution: *E. F. Estes*.

Review of Economic Statistics, February, 1933—Review of the year 1932: *W. L. Crum* and *J. E. Hubbard*. The agricultural situation, January 1933: *John D. Black*. The volume of industrial production in the United States, 1932: *Dorothy Wescott*.

Wheat Studies of the Food Research Institute, Stanford University—December, 1932—The world wheat situation, 1931-32. A review of the crop year.

January, 1933—Survey of the wheat situation, August to November, 1932.

ARGENTINA—

Revista de Ciencias Económicas—

November, 1932—El problema de la población: José Gonzales Gale.

BELGIUM—

Bulletin de l'Institut des Sciences Économiques, February, 1933—La Belgique en 1932 (including surveys of the position of agriculture, various industries, unemployment, commerce, finance, etc.).

Revue du Travail—

February, 1933—Une thèse en faveur des contingentements comme système de politique douanière. Les Américains et la "technocracy."

March, 1933—Chômage et travaux publics: L. de Brouckere. La politique du contingentement des importations et ses conséquences économiques et fiscales.

BULGARIA—

Bulletin Mensuel de Statistique, November, 1932—La population de la Bulgarie de 1881 à 1931, calculée vers le commencement et vers le milieu de chaque année.

DENMARK—

Nationaløkonomisk Tidsskrift—

Hefte 6, 1932—Et par ord om den nuværende Krise: Harald Westergaard. Statische Kostengesetze: Erich Schneider. To aktuelle Prispolitiske Spørgsmaal: A. V. Strøm Tejsen.

Hefte 1, 1933—Hindringerne for en Konjunkturopgang: Emil Lederer. Den Britiske Statsgælds-konvertering: S. Hartogsohn.

EGYPT—

L'Égypte Contemporaine—

December, 1932—Aperçu général sur les principales cultures égyptiennes (avec deux graphiques): J. Schatz.

January, 1933—L'Égypte économique et financière (avec 2 cartes hors texte): E. Minost. La crise ferroviaire et le conflit entre le rail et la route: S. E. Ahmed Ardel Wahab Pacha.

FRANCE—

Bulletin de Statistique et de Legislation Comparée, October, 1933—Les contributions directes en 1931. Les contributions indirectes en 1931-1932.

Bulletin de la Statistique Générale de la France, March, 1933—Tables de nuptialité et de fécondité pour la France (1925-1927): Michel Carsow.

Bulletin du Ministère du Travail, October-December, 1932—Le chômage en France, I. D'après les recensements professionnels.

FRANCE—*Contd.*

Journal des Économistes—

January, 1933—Devant le déficit : *Édouard Payen*. Peinture récente d'une société mécanisée : *Marc Aucuy*. La théorie quantitative et la crise économique : *E. H. Massa*.

February, 1933—Devant le déficit : *Édouard Payen*. Les prix et la crise : *Michel Carsow*. Le commerce extérieur de la France en 1932 : *E. P.*

March, 1933—Les mesures d'assainissement financier : *Edouard Payen*. Le chômage, la monnaie et les prix : *Michel Carsow*. La Chine économique : *R. J. Pierre*.

Journal de la Société de Statistique de Paris—

January, 1933—L'automobile et les transports : *J. Bouvier*.

February, 1933—Les mouvements internationaux de capitaux : *Georges Royot*.

March, 1933—La statistique des fonctionnaires : *Raymond Rivet*. *Revue d'Économie Politique*, November–December, 1932—Whole number on Charles Gide, by various authors.

GERMANY—

Blätter für Versicherungs-Mathematik, *January, 1933*—Zur mathematischen Theorie der Versicherung : *Franz Knoll*.

Deutsches Statistisches Zentralblatt, *January–February, 1933*—Aufbau und Ziele der deutschen Poststatistik : *G. Raabe*.

Vierteljahrshefte zur Konjunkturforschung, *Sonderheft 12, 1933*—Umsatz, Lagerhaltung und Kosten im deutschen Einzelhandel 1924 bis 1932 : *Bernhard Benning* and *Robert Nieschlag*.

Weltwirtschaftliches Archiv, *January, 1933*—Die säkulare Bedeutung der Weltkrise : *Wilhelm Röpke*. Die Zersplitterung und Wiederergänzung der Weltwirtschaft : *Mihail Manoilescu*. Die britische Reichswirtschaftskonferenz von Ottawa : *J. Coatman*. Die Bedeutung wirtschaftlicher Autarkie für die industrielle Struktur der Vereinigten Staaten : *Charles S. Tippetts*. Die europäische Verflechtung des amerikanischen Aussenhandels : *Hermann Levy*.

Zeitschrift für die Gesamte Versicherungs-Wissenschaft, *January, 1933*—Krisis der Sozialversicherung : *Walter Weddigen*. Die Haftpflicht des Luftfrachtführers im Warschauer Abkommen und ihre Versicherung : *Hermann Doring*.

ITALY—

Giornale degli Economisti e Rivista di Statistica—

December, 1932—Problemi economici dell'ora presente : *Giorgio Mortara*.

January, 1933—Le vie di uscita : *Giuseppe Ugo Papi*. Le responsabilità degli Stati Uniti nelle "riparazioni" : *Alberto Felletti-Spadazzi*.

February, 1933—Gli esperimenti di compartecipazione collettiva nel Mantovano : *Agostino Lanzillo*. Il consiglio nazionale delle corporazioni; notizie sul suo regolamento interno e su istituzioni estere affini : *Gerolamo Bassani*.

ITALY—*Contd.*

March, 1933—Aspetto tecnico ed economico attuale delle applicazioni chimiche: *Livio Cambi*. L'incidenza dell'imposta sull'oro-moneta: *Attilio Garino Canina*. Note sul pagamento inglese agli Stati Uniti per il debito di guerra: *Eraldo Fossati*. A proposito di alcuni appunti sul costo monetario dell'uomo: *Gaetano Pietra*.

Giornale di Matematica Finanziaria, November, 1932—Tavole di mortalità della popolazione italiana maschile in relazione ai censimenti 1901-1911-1921 e tavole di commutazione e attuariali corrispondenti: *A. Gatti*.

La Riforma Sociale, January-February, 1933—La crisi e le ore di lavoro: *Giovanni Agnelli* and *Luigi Einaudi*. Protezionismo e variazioni nel livello dei prezzi: *Vincenzo Porri*. Sul movimento dei prezzi all'ingrosso dal 1921 al 1930: *Silvio Golzio*.

Giornale dell'Istituto Italiano degli Attuari, January, 1933—Sulla determinazione empirica delle leggi di probabilità: *V. Glivenko*. Sulla probabilità massima nello schema di Poisson: *C. E. Bonferroni*. Un teorema sulla legge uniforme dei grandi numeri: *I. Messina*. A proposito di un caso limite della legge di Makeham: *B. de Finetti*.

POLAND—

Prace Instytutu Badania Konjunktur Gospodarczych i Cen, Fasc. 3-4, 1932—Les formes du crédit et la conjoncture. Essai de vérification de la théorie des crédits additionnels: *Wacaw Skrzywan*. La dispersion des prix de gros: *Jan Wisniewski*. (Polish text: French summaries.)

Revue Trimestrielle de Statistique, Fasc. 3, 1932—Sur la généralisation de la méthode de corrélation partielle pour le cas où la variable éliminée n'est pas mesurable (Polish text: French summary).

SWITZERLAND—

Journal de Statistique et Revue Économique Suisse—

Fasc. 3, 1932—Auf der Suche nach Ursachen. Einige Bemerkungen zur statistischen Methodenlehre: *Arnold Schwartz*.

Fasc. 4, 1932—L'amortissement industriel dans les entreprises ferroviaires: *Édouard Fallet*. Betrachtungen über den Einfluss der Effektenbörsen und Banken auf die Konjunktur: *Adolf Liechti*.

INTERNATIONAL—

L'Esprit International, April, 1933—La Conférence Économique Mondiale: *Sir Arthur Salter*.

International Labour Review—

January, 1933—The social consequences of a return to gold: an analysis of certain current proposals for an international monetary standard: *P. W. Martin* and *E. J. Riches*.

INTERNATIONAL—*Contd.*

International Labour Review—*Contd.*

February, 1933—Housing problems and the depression: *G. Mequet*. The development of employers' organisations in India: *A. H. Maru*.

March, 1933—The Preparatory Conference on the Forty-hour Week: *Fernand Maurette*. Technical progress and unemployment: *Mentor Bouniatian*.

Metron, Vol. X, No. 4—Sulle relazioni tra curve di frequenza e curve di concentrazione e sui rapporti di concentrazione corrispondenti a determinate distribuzioni: *V. Castellano*. Ueber Näherungs-parabeln hohen Grades und ihre Aufgabe in der Konjunkturforschung: *P. Lorenz*. Tavole di morbidità e frequenza delle malattie per i prestatori d'opera del commercio (esperienza 1931): Cassa Nazionale Malattie per gli Addetti al Commercio.

ADDITIONS TO THE LIBRARY.

Since the issue of Part I, 1933, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS.

(a) United Kingdom and its several Divisions.

United Kingdom—

- Agriculture, Ministry of.* Economic series No. 38. Report of the Reorganisation Commission for Milk. London : H.M.S.O., 1933. 9 $\frac{1}{4}$ " \times 6"; 228 pp. 6d.
- Colonial Office.* Report by Mr. Roger Gibb on railway rates and finance in Kenya, Uganda, and Tanganyika Territory. London : H.M.S.O., 1933. 9 $\frac{1}{4}$ " \times 6"; 56 pp. 1s. 6d.
- Control, Board of.* Mental Deficiency Acts, 1913–1927. "Local Authority" institutions : average weekly cost per patient for the year ended 31 March, 1932. London : H.M.S.O., 1933. 13 $\frac{1}{2}$ " \times 8 $\frac{1}{2}$ "; 4 sheets. 6d.
- Economic Advisory Council.* Tsetse Fly Committee. Report. London : H.M.S.O., 1933. 9 $\frac{1}{4}$ " \times 6"; 27 pp. 6d.
- Electricity Commission.* Report on the measures which have been taken in this country and others to obviate the emission of soot, ash, grit and gritty particles from the chimneys of electric power stations. London : H.M.S.O., 1932. 10 $\frac{1}{2}$ " \times 7 $\frac{1}{2}$ "; 58 pp. 5s.
- Empire Marketing Board—*
- Survey of oilseeds and vegetable oils, Vol. II. Coconut palm products, a summary of production and trade in the Empire and foreign countries. 196 pp. 2s.
- Plantation crops, a summary of figures of production and trade relating to sugar, tea, coffee, spices, cocoa, rubber, tobacco. 63 pp. 6d.
- Production and trade of the British West Indies, British Guiana, Bermuda and British Honduras. 78 pp. 2d.
- [London : H.M.S.O., 1932–33. 9 $\frac{3}{4}$ " \times 7 $\frac{1}{4}$ "]
- Forestry Commission.* Report on census of production of home-grown timber. London : H.M.S.O., 1932. 9 $\frac{1}{4}$ " \times 6"; 13 pp. 3d.
- General Register Office—*
- Census of England and Wales, 1931. County of Bedford (Part I). xix + 22 pp. 2s. 6d. County of Berkshire (Part I). xviii + 30 pp. 2s. 6d. County of Buckingham (Part I). xviii + 29 pp. 2s. 6d. County of Chester (Part I). xxi + 61 pp. 4s. County of Hampshire (Part I). xxi + 59 pp. 3s. 6d. County of Northumberland (Part I). xx + 45 pp. 3s. County of Oxford (Part I). xix + 31 pp. 2s. 6d. County of Stafford (Part I). xxii + 56 pp. 3s. 6d. County of Sussex (Part I). xxii + 54 pp. 3s. 6d. County of Warwick (Part II). 15 pp. 9d. County of Worcester (Part I). xx + 37 pp. 2s. 6d.
- [London : H.M.S.O., 1933. 13" \times 8"]
- Industrial Health Research Board.* Report No. 67. Manual dexterity effects of training. I. Transfer of training in manual dexterity and visual discrimination. By *E. M. Henshaw, P. Holman, and J. N. Langdon*. II. Distribution of practice in manual dexterity. By *E. M. Henshaw and P. Holman*. London : H.M.S.O., 1933. 9 $\frac{1}{4}$ " \times 6"; vii + 45 pp. 1s.
- Health, Ministry of.* Reports on public health and medical subjects. No. 69. Report on an outbreak of enteric fever in the Malton Urban District. London : H.M.S.O., 1933. 9 $\frac{1}{4}$ " \times 6"; 16 pp. 1s. 6d.
- Mines Department.* Miners' Welfare Fund. Departmental Committee of Inquiry (1931) Report. London : H.M.S.O., 1933. 9 $\frac{1}{4}$ " \times 6"; 93 pp. 1s. 6d.

(a) United Kingdom and its several Divisions—*Contd.***United Kingdom—*Contd.***

New Scotland Yard. Instructions in the method of taking finger prints; with a memorandum on the working of the finger print system of identification. London: H.M.S.O., 1932. 9½" × 6"; 18 pp. 6d.

Overseas Trade, Department of—

Reports: 535. Ecuador. Sept. 1932. 44 pp. 1s. 6d. 536. Republic of Panama, and the Panama Canal Zone. 1931–32. 35 pp. 1s. 537. Portuguese East Africa. Oct. 1932. 94 pp. 2s. 6d. 538. Guatemala, Honduras, and Nicaragua. 104 pp. 3s.

[London: H.M.S.O., 1933. 9½" × 6".]

Report from the Joint Committee on Gas Undertakings (Basic Prices) together with the proceedings of the Committee and minutes of evidence. London: H.M.S.O., 1933. 9½" × 6"; 114 pp. 4s.

Royal Commission on Lotteries and Betting, 1932–3. Interim Report. London: H.M.S.O., 1933. 9½" × 6"; 22 pp. 6d.

Trade, Board of. Second interim report of the Gas Legislation Committee. London: H.M.S.O., 1933. 9½" × 6"; 20 pp. 4d.

Scientific and Industrial Research, Department of. Summary of progress of the geological survey of Great Britain and the Museum of Practical Geology for the year 1931. Part II. London: H.M.S.O., 1932. 9½" × 6"; 166 pp. 3s.

Scotland—

Census Office. Census of Scotland, 1931. Vol. 1. Parts: 21. County of Lanark. 3s. 22. County of Midlothian. 2s. 23. Counties of Moray and Nairn. 3s. 24. County of Orkney. 2s. 25. County of Peebles. 1s. 6d. 26. Counties of Perth and Kinross. 3s. 6d. 27. County of Renfrew. 2s. 6d.

[Edinburgh: H.M.S.O., 1933. 13½" × 8½".]

Health, Department of. Consultative Council on Local Health Administration and General Health Questions. Report of the Consultative Council in regard to the steps necessary to secure that state-aided houses will in future be let only to persons of the working classes. Edinburgh: H.M.S.O., 1932. 9½" × 6"; 23 pp. 4d.

(b) India, Dominions, Colonies, and Protectorates.

India—

Bhavnagar State. Census, 1931. Part I. Report. 283 pp. Rs. 4. Part II. Imperial and State tables. Rs. 1.8. Bhavnagar, 1932. 13" × 8½".

Canada—

Dominion Bureau of Statistics. Monthly indexes of the physical volume of business in Canada in the post-war period from 1919 to 1932, adjusted for seasonal tendencies (issued as Supplement to Monthly Review of Business Statistics, Nov. 1932). Ottawa, 1932. 11" × 8½"; 35 pp.

Union of South Africa—

Fifth census of the population of the Union of South Africa 5th May, 1931. Report with summaries and analysis: number, sex, geographical distribution, and ages of the European population. Pretoria, 1933. 12" × 9½"; xliii + 105 pp. 7s. 6d.

Nigeria—

Census of Nigeria, 1931. Vol. I. Nigeria. vii + 155 pp. 10s. 6d. Vol. II. Census of the Northern Provinces. 234 pp. 12s. Vol. III. Medical census, Southern Provinces. 46 pp. 4s. Vol. V. Medical census, Northern Provinces. 92 pp. 7s. Vol. VI. Medical census, Southern Provinces. 101 pp. 8s.

[London: Crown Agents for the Colonies, 1932. 13" × 8".]

(c) Foreign Countries.

Austria—

Bundesamt für Statistik. Gewerbliche Betriebszählung in der Republik Österreich vom 14 Juni 1930. Gesamtergebnisse für Österreich. Wien, 1932. 14" × 10½"; 101 pp.

Bulgaria—

Direction Général de Statistique—

Statistique de l'industrie encouragée, 1929. Sofia, 1932. 11½" × 8"; 41 pp.

Résultats du recensement des établissements industriels et commerciaux . . . 31 déc. 1926. Tome II. Sofia, 1932. 11½" × 8"; 399 pp.

Czechoslovakia—

Office de Statistique. Industrie meunière dans la République Tchécoslovaque pendant les campagnes du 1/vii/1926 au 30/vi/1927 et du 1/vii/1927 au 30/vi/1928. Prague, 1931. 12" × 9½"; xl + 240 pp.

France—

Ministère des Colonies. Bulletin de l'Agence Générale des Colonies. 25e année. No. 285 (Dec. 1932) and foll. Paris, 1932. 9½" × 6¼".

Germany—

Bavaria. Statistisches Landesamt. Jubiläumsschrift herausgegeben vom Bayerischen Statistischen Landesamt—

Bayern im Lichte seiner hundertjährigen Statistik. Munich, 1933. 10½" × 7¼"; 100 pp.

Hundert Jahre Bayerisches Statistisches Landesamts. Munich, 1933. 10½" × 7¼"; 192 pp.

Hungary—

Budapest. Kommunal Statistisches Amt. Die sozialen und wirtschaftlichen Verhältnisse der Arbeiter in Budapest. Budapest, 1930. 10¼" × 7¼"; 38 + 1143 pp.

Italy—

Istituto Centrale di Statistica. Annali di Statistica. Serie VI. Vol. XX. Dinamica dei prezzi delle merci in Italia dal 1870 al 1929. By *Ernesto Cianci*. Rome, 1933. 10¼" × 7¼"; xii + 558 pp. L. 35.

Malaya—

Malayan statistics, 1933 issue, compiled by *C. S. Alexander*. London: Malayan Information Agency, 1933. 9½" × 6½"; 178 pp. 2s.

Poland—

Office Central de Statistique. Abatage des animaux de ferme en 1931. Warsaw, 1933. 10½" × 8¼"; 31 pp.

Switzerland—

Statistisches Amt. Turnprüfung bei der Rekrutierung, 1931. Berne, 1932. 11½" × 8¼"; 38 pp.

Berne. Statistisches Bureau. Die Kriminalität im Kanton Bern eine Untersuchung über Delikt und Delinquent anhand der Kriminalstatistik des Kantons Bern für die Jahre 1924–29 und einer Enquete über besonders straffällige Personen. Bern, 1932. 9½" × 6½"; 270 pp.

Turkey—

Ministère des Douanes et des Monopoles—

Statistique annuelle du commerce extérieur de la Turquie, 1931. Parti I. Ankara, 1932. 13" × 9½"; lvi + 176 pp.

Statistique mensuelle du commerce extérieur de la Turquie, Dec. 1932. Ankara, 1933. 13" × 9½"; 92 pp.

(c) Foreign Countries—*Contd.*

United States—

Agriculture, Department of—

Report on the agricultural experiment stations, 1931. 146 pp. 10 c.

Technical bulletins: 322. Agricultural credit corporations affiliated with cotton co-operative marketing associations. 64 pp. 10 c.

— 324. An economic study of the Pecan industry. 90 pp. 10 c.

Federal Trade Commission:—

Price bases inquiry. The basing-point formula and cement prices. 218 pp. 30 c.

Utility corporations. Letter from the Chairman of the Federal Trade Commission transmitting in response to Senate Resolution No. 83, 70th Congress, a monthly report on the Electric Power and Gas Utilities Inquiry. No. 41. Tide Water Power Co., Florida Power Corporation, Nebraska Co. xiv + 836 pp.

Labor Statistics, Bureau of—

Bulletins: 567. Wages and hours of labor in the iron and steel industry. 166 pp. 15 c.

— 572. Wholesale prices 1931. 114 pp. 10 c.

— 573. Wages and hours of labor in metalliferous mines 1924 and 1931. 64 pp. 10 c.

— 574. Technological changes and employment in the United States postal service. 69 pp. 10 c.

— 575. Wages and hours of labor in air transportation, 1931. 41 pp. 5 c.

Women's Bureau—

Bulletins: 100. The effects on women of changing conditions in the cigar and cigarette industries. 184 pp.

— 101. The employment of women in vitreous enameling. 64 pp. 10 c. [Washington, 1932-33. 9" × 6".]

(d) International.

League of Nations—

Economic and Financial Section—

Agreement signed at Geneva on Jan. 28, 1933, establishing an advisory technical collaboration in Roumania. 13" × 8"; 15 pp.

Monetary and Economic Conference. Draft annotated agenda submitted by the preparatory commission of experts. 10½" × 8"; 37 pp.

Recommendations of the Economic Committee relating to tariff policy and the most-favoured-nation clause. 13" × 8"; 23 pp.

[Geneva, 1933.]

II.—AUTHORS AND MISCELLANEOUS.

Åkerman (Johan). Det ekonomiska läget 1928-1932. Stockholm: Sveriges Industriförbund, 1932. 9½" × 6¼"; viii + 1159 pp. (From the author.)

— Economic forecast and reality 1928-1932. Stockholm: Nordiska Bokhandeln, 1933. 10" × 7"; 46 pp. (*Id.*)

Auckland University College. Bulletin No. 21. Economic series No. 7. The New Zealand budgetary problem. By *L. W. Holt*. Auckland: University College, 1932. 8½" × 5½"; 39 pp. 1s. 6d.

Bhattacharyya (N. C.) and *Natesan (L. A.)*, editors. Some Bengal villages: an economic survey. Calcutta: the University, 1933. 9½" × 6¼"; xii + 225 pp.

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 7. Deaths associated with anaesthesia.
 8. Malaria in Mississippi and adjacent States.
 9. The Ross Award Fund.
 10. Address delivered at Presentation . . . to Professor R. Matas.
 11. Finland show workings of prohibition.
 12. An air journey to Great Slave Lake.
 13. Right weights for health.
 14. Hawaii.
 15. The fatal accident problem in the United States.
 16. Seventeenth to twentieth Quarterly Reports of San Francisco Cancer Survey.
 17. Suicides, a New York problem.
 18. Tropical mortality statistics.
 19. Investigating capital punishment.
 20. The homicide problem of 1931.
 21. Hope and faith, qualities which make life livable.
 22. Public interest in voting.
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 24. Germans show preference for low-alcoholic beers.
 25. The suicide record for 1931.
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Exports: Declared value of U.K. Produce and Manufactures, and of Imported Merchandise, exported from the United Kingdom in the years ended December 31, 1930, 1931, 1932.

Countries to which consigned.	1930.		1931.		1932.	
	Exports.	Re-exports.	Exports.	Re-exports.	Exports.	Re-exports.
	£'000.	£'000.	£'000.	£'000.	£'000.	£'000.
Russia	6,772	2,519	7,291	1,912	9,274	1,222
Finland	2,414	430	1,604	170	2,263	238
Sweden	10,068	868	7,744	719	6,887	670
Norway	12,931	342	7,559	301	5,804	340
Denmark,* with Faroe Islands	10,248	742	8,657	557	9,860	501
Poland, including Dantzic ...	3,564	616	2,004	574	1,997	672
Germany	26,809	17,308	18,412	13,590	14,581	10,832
Netherlands *	18,860	4,149	13,701	2,998	12,108	2,379
Java	4,510	91	2,507	84	2,458	47
Belgium *	15,035	6,544	10,025	4,547	8,745	4,119
France *	29,690	14,508	22,552	9,468	18,460	8,327
Switzerland	5,187	1,096	4,138	853	3,710	738
Portugal	3,363	428	2,455	204	2,584	184
Spain *	9,334	527	5,294	222	5,225	354
Italy,* including Fiume	13,835	957	9,917	727	8,637	790
Czechoslovakia	1,731	116	1,337	127	960	117
Greece	3,732	195	3,179	136	2,177	132
Roumania.....	1,947	39	1,333	29	1,757	32
Turkey, European and Asiatic, incl. Smyrna and Armenia...	1,868	73	1,715	66	1,484	51
Egypt	9,808	192	6,650	158	6,513	132
China †	8,574	86	7,859	115	7,778	88
Japan †	8,229	168	6,187	145	5,733	109
United States	28,705	11,229	18,246	7,967	15,098	5,737
Cuba	1,283	32	656	18	695	23
Mexico	2,433	30	943	35	1,089	19
Peru	1,443	56	664	41	728	37
Chile	5,963	321	1,932	216	662	107
Brazil	7,970	172	4,063	106	4,675	152
Uruguay	3,578	56	1,985	33	1,501	26
Argentine Republic.....	25,234	442	14,785	270	10,663	203
Other countries	37,292	2,024	24,555	1,416	25,500	974
<i>Total—Foreign Countries ...</i>	<i>322,410</i>	<i>66,356</i>	<i>219,949</i>	<i>47,804</i>	<i>199,606</i>	<i>39,352</i>
BRITISH POSSESSIONS.						
Irish Free State	34,497	9,798	30,511	8,538	25,774	6,081
British West Africa	10,730	1,181	6,321	643	7,918	636
Union of South Africa	26,661	1,242	21,931	1,075	18,176	522
British East Africa	4,526	111	3,001	84	2,269	57
British India with Burma	52,944	1,283	32,289	801	34,091	589
Straits Settlements and Federated Malay States.....	10,401	304	6,282	199	5,657	135
Ceylon and Dependencies	3,998	162	2,703	117	2,486	70
Australia	31,678	1,391	14,528	625	20,025	592
New Zealand	17,867	762	11,196	535	10,360	289
Canada	29,138	2,108	20,551	1,600	16,409	976
Brit. W. Indies, with Bahamas	4,749	297	3,876	299	4,622	224
Other Possessions	21,156	1,840	17,484	1,547	17,785	1,391
<i>Total—British Possessions</i>	<i>248,345</i>	<i>20,479</i>	<i>170,673</i>	<i>16,063</i>	<i>165,532</i>	<i>11,562</i>
Total—Foreign Countries and British Possessions ...	570,755	86,835	390,622	63,867	365,138	50,914

* Excluding colonies.

† Excluding Hong Kong, Macão, and leased territories; including Weihaiwei as from 1st October, 1930.

‡ Including Formosa and leased territories; excluding Korea.

Imports.—Declared value of merchandise imported into the United Kingdom in the years ended December 31, 1930, 1931, 1932.

Countries from which consigned.	1930.	1931.	1932.
	£'000.	£'000.	£'000.
Russia	34,235	32,286	19,697
Finland	12,634	11,630	11,737
Sweden	22,581	17,342	13,425
Norway	11,967	8,630	8,253
Denmark,* including Faroe Islands	54,118	46,695	40,556
Poland, including Dantzic	7,949	8,612	6,185
Germany	65,490	64,162	30,410
Netherlands *	39,524	35,199	22,001
Java	6,587	4,556	4,745
Belgium *	38,016	33,190	15,990
France *	49,267	40,921	19,023
Switzerland	12,640	11,362	5,158
Portugal *	3,655	3,309	2,589
Spain *	16,638	14,249	12,755
Italy *	15,005	15,148	10,825
Czechoslovakia	6,403	6,620	3,037
Greece (excluding Crete)	2,050	2,026	2,330
Roumania.....	4,726	3,412	3,465
Turkey, European and Asiatic, including Smyrna and Armenia	1,870	1,475	1,620
Egypt	13,909	10,841	10,406
China †	9,889	7,773	6,202
Japan †	7,820	6,952	6,693
United States	153,497	104,009	83,672
Cuba	6,874	4,292	5,336
Mexico	2,886	2,397	2,430
Peru	4,494	3,510	4,389
Chile	7,272	4,483	3,859
Brazil	8,111	5,704	4,120
Uruguay	7,387	5,230	3,042
Argentine Republic.....	56,666	52,744	50,870
Other countries	55,786	45,085	39,298
<i>Total—Foreign Countries</i>	739,946	613,836	454,118
BRITISH POSSESSIONS.‡			
Irish Free State	42,955	36,547	26,531
British West Africa	8,159	4,891	5,585
Union of South Africa	20,350	13,133	15,720
British East Africa	4,453	3,669	3,687
British India, with Burma	51,044	36,711	32,315
Straits Settlements and Federated Malay States	11,393	6,453	4,805
Ceylon and Dependencies	13,483	11,996	10,353
Australia	46,449	45,679	46,192
New Zealand	44,899	37,775	37,485
Canada	38,146	32,840	43,146
British W. Indies, with Bahamas.....	5,134	4,389	5,437
Other Possessions	17,564	13,333	17,759
<i>Total—British Possessions</i>	304,029	247,416	249,015
Total—Foreign Countries and British Possessions	1,043,975	861,252	703,133

* Excluding colonies.

† Excluding Hong Kong, Macão and leased territories.

‡ Including Formosa and leased territories.

§ Including Protectorates and Mandated Territories.

REGISTRATION OF THE UNITED KINGDOM.

No. I.—ENGLAND AND WALES.

A.—*Serial Table of BIRTHS, DEATHS and MARRIAGES, returned in the Years 1926–1932, and in the QUARTERS of those Years.*

Calendar YEARS, 1926–1932 :—Numbers.

YEARS	1926.	1927.	1928.	1929.	1930.	1931.	1932.*
Births	694,563	654,172	660,267	643,673	648,811	632,081	613,972
Stillbirths ...	—	—	27,580	26,847	27,577	26,933	26,437
Deaths	453,804	484,609	460,389	532,492	455,427	491,630	484,083
Marriages	279,860	308,370	303,228	313,316	315,109	311,847	306,132

(I.) LIVE BIRTHS :—*Numbers in QUARTERS of each Calendar Year, 1926–1932.*

QUARTERS.	1926.	1927.	1928.	1929.	1930.	1931.	1932.*
Jan.—Mar. ...	173,997	166,974	167,926	160,047	158,545	159,663	152,116
Apr.—June ...	181,332	170,778	170,997	169,451	170,042	163,760	165,403
July—Sept. ...	174,837	163,854	165,675	163,777	165,596	161,133	156,186
Oct.—Dec.	164,397	152,566	155,669	150,398	154,628	147,525	140,267

(II.) STILLBIRTHS :—*Numbers.*

QUARTERS.	1926.	1927.	1928.	1929.	1930.	1931.	1932.*
Jan.—Mar. ...	—	—	7,077	6,878	7,069	7,091	6,868
Apr.—June ...	—	—	7,126	6,937	7,098	6,940	7,137
July—Sept. ...	—	6,198	6,617	6,569	6,850	6,568	6,283
Oct.—Dec.	—	6,388	6,760	6,463	6,560	6,334	6,149

(III.) DEATHS (*excluding stillbirths*) :—*Numbers.*

QUARTERS.	1926.	1927.	1928.	1929.	1930.	1931.	1932.*
Jan.—Mar. ...	130,611	168,760	136,299	204,309	131,967	162,208	153,426
Apr.—June ...	113,809	107,595	114,742	118,728	111,336	114,694	116,248
July—Sept. ...	90,705	92,238	93,715	96,749	96,389	96,735	97,951
Oct.—Dec.	118,679	116,016	115,633	112,706	115,735	117,993	116,458

(IV.) MARRIAGES :—*Numbers.*

QUARTERS.	1926.	1927.	1928.	1929.	1930.	1931.	1932.*
Jan.—Mar. ...	46,228	47,940	45,250	54,426	48,825	46,574	62,068
Apr.—June ...	78,393	84,963	84,788	75,488	88,138	85,380	68,600
July—Sept. ...	83,830	91,888	94,478	100,669	98,392	99,415	94,662
Oct.—Dec. ...	71,409	83,579	78,712	82,733	79,754	80,478	80,802

* Provisional.

Annual Rates of BIRTHS, DEATHS and PERSONS MARRIED, per 1,000 PERSONS
LIVING in the Years 1925-1932, and in the QUARTERS of those Years.

Calendar YEARS, 1925-1932 :—General Ratios.

YEARS.....	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.*
Estd. Popln. in thousands in middle of each Year	38,890,	39,067,	39,290,	39,482,	39,607,	39,806,	39,988,	40,201,*
Live Births ...	18·3	17·8	16·6	16·7	16·3	16·3	15·8	15·3
Stillbirths ...	—	—	—	0·70	0·68	0·69	0·67	0·66
Deaths	12·2	11·6	12·3	11·7	13·4	11·4	12·3	12·0
Persons Mar- ried	15·2	14·3	15·7	15·4	15·8	15·8	15·6	15·2

(I.) BIRTHS :—Ratio per 1,000, in QUARTERS of each Calendar Year, 1925-1932.

QUARTERS.	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.*
Jan.—Mar. ...	18·3	18·1	17·2	17·1	16·4	16·2	16·2	15·2
Apr.—June ...	19·3	18·6	17·4	17·4	17·2	17·1	16·4	16·5
July—Sept. ...	18·6	17·8	16·5	16·7	16·4	16·5	16·0	15·5
Oct.—Dec.	17·0	16·7	15·4	15·7	15·1	15·4	14·6	13·9

(II.) STILLBIRTHS :—Ratio per 1,000.

QUARTERS.	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.*
Jan.—Mar. ...	—	—	—	0·72	0·70	0·72	0·72	0·69
Apr.—June ...	—	—	—	0·73	0·70	0·72	0·70	0·71
July—Sept. ...	—	—	0·63	0·67	0·66	0·68	0·65	0·62
Oct.—Dec.	—	—	0·65	0·68	0·65	0·65	0·63	0·61

(III.) DEATHS (excluding stillbirths) :—Ratio per 1,000.

QUARTERS.	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.*
Jan.—Mar. ...	14·4	13·6	17·4	13·9	20·9	13·4	16·5	15·3
Apr.—June ...	11·7	11·7	11·7	11·0	12·0	11·2	11·5	11·6
July—Sept. ...	9·7	9·2	9·3	9·4	9·7	9·6	9·6	9·7
Oct.—Dec.	12·9	12·1	11·7	11·7	11·3	11·5	11·7	11·5

(IV.) PERSONS MARRIED :—Ratio per 1,000.

QUARTERS.	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.*
Jan.—Mar. ...	9·6	9·6	9·9	9·2	11·1	9·9	9·4	12·4
Apr.—June ...	16·9	16·1	17·3	17·3	15·3	17·8	17·1	13·7
July—Sept. ...	18·4	17·0	18·6	19·0	20·2	19·6	19·7	18·7
Oct.—Dec.	15·7	14·5	16·9	15·9	16·6	15·9	16·0	15·9

* Provisional figures.

B.—Special Town Table :—POPULATION; BIRTH-RATE and DEATH-RATE (Civilians) in each Quarter of 1932, in certain of the 118 Great Towns.

Cities and boroughs.	Estimated resident population mid-1931.	Annual Rate to 1,000 Living during the thirteen weeks ending							
		April 2, 1932. (1st quarter.)		July 2, 1932. (2nd quarter.)		Oct. 1, 1932. (3rd quarter.)		Dec. 31, 1932. (4th quarter.)	
		Live Births	Deaths†	Live Births	Deaths†	Live Births	Deaths†	Live Births	Deaths†
118 Great towns ...	20,540,010	15.6	15.3	16.7	11.3	15.5	9.3	13.9	11.5
<i>Including—</i>									
London (Met. Bs.)	4,374,300*	14.3	16.0	15.3	11.4	14.2	9.3	12.8	11.4
West Ham C.B....	296,700	17.0	14.8	17.4	10.0	16.5	8.8	15.9	10.6
Croydon C.B. ...	233,800	14.1	15.1	15.0	9.3	14.4	8.4	12.7	9.9
Brighton C.B. ...	145,000*	13.3	19.0	13.9	11.5	13.1	10.9	11.7	12.9
Portsmouth C.B. †	257,500*	16.5	17.4	17.5	11.1	16.6	10.1	15.0	13.6
Bristol C.B.	399,900*	15.0	15.2	15.9	11.4	15.5	9.0	14.1	10.5
Cardiff C.B.	223,800*	14.1	14.5	17.4	11.7	16.1	10.1	14.6	12.2
Swansea C.B. ...	165,500	16.0	14.6	17.6	10.8	16.5	9.1	14.8	11.0
Wolverh'ton C.B.	134,400	16.8	13.5	17.5	9.8	15.7	9.2	14.8	12.5
Birmingham C.B.	1,012,700	16.1	14.5	17.7	9.9	17.0	8.5	14.2	11.6
Norwich C.B. ...	126,800*	15.1	16.4	15.5	11.9	15.6	9.0	12.3	10.5
Leicester C.B. ...	241,300	14.5	16.5	17.4	10.9	14.4	9.4	13.2	12.1
Nottingham C.B.	270,900	16.6	14.9	17.9	12.3	16.0	10.0	14.8	11.2
Derby C.B.	143,600*	13.9	14.3	14.9	11.3	14.7	8.6	13.5	10.9
Birkenhead C.B.	148,500	17.3	13.1	19.9	10.4	17.1	8.8	16.1	10.8
Liverpool C.B. †	863,300	22.2	15.1	22.4	13.1	20.8	10.5	18.7	13.2
Bolton C.B.	179,200	13.4	15.3	14.6	11.7	13.7	10.3	11.7	11.3
Manchester C.B.	773,900	16.0	16.9	16.5	12.3	14.8	9.6	13.8	11.8
Salford C.B.	225,900	15.4	15.5	16.2	11.8	15.9	9.5	13.4	12.3
Oldham C.B.	141,900	13.3	17.5	13.2	13.2	12.7	11.1	11.3	12.0
Burnley C.B.	99,180	12.4	14.7	12.0	11.8	11.4	10.4	11.1	12.2
Blackburn C.B....	123,900	12.3	14.5	14.3	12.1	12.7	10.7	10.6	11.3
Preston C.B.	120,100	15.8	16.5	15.7	12.1	14.6	10.4	12.7	11.7
Huddersfield C.B.	114,300	11.6	16.5	12.6	11.8	12.0	9.5	10.7	11.9
Halifax C.B.	98,750*	13.0	17.8	12.8	14.3	10.4	11.7	11.8	13.3
Bradford C.B. ...	300,900	13.8	16.3	13.7	14.0	13.3	10.6	12.4	12.9
Leeds C.B.	486,400	14.1	15.6	15.9	12.8	14.3	10.1	13.1	13.4
Sheffield C.B. ...	517,300	14.6	14.2	15.2	10.1	14.1	8.7	13.2	11.3
Kingston-upon-									
Hull C.B.	315,200	19.1	14.6	20.3	11.4	18.7	9.5	17.4	11.7
Sunderland C.B.	187,600	23.1	16.0	22.5	13.4	20.0	10.3	19.4	13.8
Gateshead C.B. ...	123,700	21.3	15.4	19.6	12.0	17.3	12.0	17.4	12.4
Newcastle-on-									
Tyne C.B.	284,400*	17.4	13.9	18.9	11.8	16.8	9.5	15.6	13.6

* Excluding non-civilian deaths.

† Boundary changed Apr. 1, 1932.

† Excluding stillbirths.

Note.—The 118 great towns are those with populations exceeding 50,000 persons at the Census of 1931; before the second quarter of 1927 the figures referred to 105 towns only, from 1927 to 1931 to 107 towns, and in the first quarter of 1932 to 117 towns.

No. II.—SCOTLAND.

BIRTHS, DEATHS AND MARRIAGES IN THE YEAR ENDED
DECEMBER 31, 1932.

I.—Serial Table :—Number of BIRTHS, DEATHS and MARRIAGES in Scotland, and their¹ Proportion to the Population estimated to the Middle of each Year, during each Quarter of the Years 1928–1932 inclusive.

	1928.		1929.		1930.		1931.		1932.	
	Number.	Per 1,000.	Number.	Per 1,000.	Number.	Per 1,000.	Number.	Per 1,000.	Number.	Per 1,000.
1st Quarter—										
Births	24,252	20·1	23,449	19·6	23,686	19·8	23,558	19·7	23,068	19·0
Deaths ...	19,387	16·1	26,386	22·1	19,055	15·9	20,189	16·9	19,634	16·2
Marriages	7,383	6·1	6,727	5·6	7,297	6·1	7,075	5·9	7,691	6·3
2nd Quarter—										
Births	25,723	21·3	24,380	20·2	24,822	20·5	24,130	20·0	24,250	20·0
Deaths ...	16,567	13·7	15,895	13·1	15,889	13·2	15,916	13·2	16,410	13·5
Marriages	7,905	6·6	8,117	6·7	8,285	6·9	8,157	6·8	7,881	6·4
3rd Quarter—										
Births	23,444	19·2	23,053	18·9	22,954	18·8	22,659	18·6	22,030	18·0
Deaths ...	13,458	11·1	13,283	10·9	13,356	10·9	13,244	10·9	13,191	10·8
Marriages	9,236	7·6	9,686	7·9	9,528	7·8	9,353	7·7	9,343	7·6
4th Quarter—										
Births	23,403	19·2	21,998	18·0	23,087	18·9	21,873	17·9	21,653	17·1
Deaths ...	15,859	13·0	15,353	12·6	15,985	13·1	14,880	12·2	16,812	13·7
Marriages	8,424	6·9	8,437	6·9	8,205	6·7	8,084	6·6	8,262	6·7
Year—										
Population	4,848,000		4,832,000		4,828,000		4,842,554		4,880,000	
Births	96,822	19·9	92,880	19·2	94,549	19·5	92,220	19·0	91,001	18·6
Deaths ...	65,271	13·4	70,917	14·6	64,285	13·3	64,229	13·3	66,047	13·5
Marriages	32,948	6·8	32,967	6·8	33,315	6·9	32,669	6·7	33,177	6·8

II.—*Number of Births, Deaths, and Marriages in the 263 Large Burghs and Other Districts of SCOTLAND and their proportion to the population during each quarter of 1932.*

	Births.		Deaths.		Marriages.	
	Number.	Annual rate per 1,000 persons	Number	Annual rate per 1,000 persons	Number.	Annual rate per 1,000 persons.
<i>1st quarter—</i>						
Large Burghs	13,114	19·8	11,039	16·6	4,814	7·3
includ- { Glasgow	5,924	21·5	4,746	17·3	2,175	7·9
{ Edinburgh	1,728	15·6	1,862	16·8	812	7·3
{ Dundee	861	19·5	640	14·5	278	6·3
Other Districts	9,954	18·1	8,595	15·6	2,877	5·2
<i>2nd quarter—</i>						
Large Burghs	13,801	20·8	9,079	13·7	4,907	7·4
includ- { Glasgow	6,140	22·3	3,808	13·8	2,138	7·8
{ Edinburgh	1,795	16·2	1,448	13·1	923	8·3
{ Dundee	922	20·9	661	15·0	315	7·1
Other Districts	10,449	19·0	7,331	13·3	2,974	5·4
<i>3rd quarter—</i>						
Large Burghs	12,228	18·2	7,280	10·9	6,373	9·5
includ- { Glasgow	5,412	19·5	2,999	10·8	2,738	9·8
{ Edinburgh	1,713	15·3	1,231	11·0	1,302	11·6
{ Dundee	755	16·9	535	12·0	414	9·3
Other Districts	9,802	17·6	5,911	10·6	2,970	5·3
<i>4th quarter—</i>						
Large Burghs	12,091	18·0	9,686	14·4	5,074	7·6
includ- { Glasgow	5,257	18·9	4,518	16·2	2,152	7·7
{ Edinburgh	1,724	15·4	1,491	13·3	895	8·0
{ Dundee	737	16·5	609	13·7	282	6·3
Other Districts	9,562	17·2	7,126	12·8	3,188	5·7

No. III.—NORTHERN IRELAND.

NORTHERN IRELAND.—*Number of Births, Deaths and Marriages for each Quarter of 1932 and their Proportion to the Population.*

	Births.		Deaths.		Marriages.	
	Number.	Annual rate per 1,000 of population.	Number.	Annual rate per 1,000 of population.	Number.	Annual rate per 1,000 of population.
1st quarter ...	6,456	20·6	5,367	17·1	1,904	6·1
2nd „ ...	6,586	21·0	4,629	14·7	1,565	5·0
3rd „ ...	6,457	20·6	3,718	11·8	1,530	4·9
4th „ ...	5,685	18·1	4,103	13·1	2,114	6·7
Total for year 1932	25,184	20·0	17,817	14·2	7,113	5·7

Population of Northern Ireland, estimated provisionally to mid-1932 (inclusive of military) :—1,256,000.

	Births.		Deaths.		Marriages.	
	Number.	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.
1st quarter—						
Total rural districts	2,747	17·8	2,616	16·9		
Total co. boroughs and urban dists.	3,709	23·2	2,751	17·2		
Belfast C.B. ...	2,335	22·6	*1,845	17·8		
Londonderry C.B.	307	27·3	191	17·0		
2nd quarter—						
Total rural districts	2,884	18·7	2,454	15·9		
Total co. boroughs and urban dists.	3,702	23·2	2,175	13·6		
Belfast C.B. ...	2,360	22·8	*1,413	13·7		
Londonderry C.B.	312	27·7	153	13·6		
3rd quarter—						
Total rural districts	2,977	19·3	1,907	12·4		
Total co. boroughs and urban dists.	3,480	21·8	1,811	11·3		
Belfast C.B. ...	2,200	21·3	*1,159	11·2		
Londonderry C.B.	327	29·0	133	11·8		
4th quarter—						
Total rural districts	2,551	16·5	2,027	13·1		
Total co. boroughs and urban dists.	3,134	19·6	2,076	13·0		
Belfast C.B. ...	1,987	19·2	*1,366	13·2		
Londonderry C.B.	231	20·5	172	15·3		

* Including deaths of persons admitted from Belfast into institutions outside the co. borough, numbering 59, 83, 49 and 65 in the respective quarters.

No. IV.—IRISH FREE STATE.

Number of Births, Deaths and Marriages in the Irish Free State for each quarter of the year 1932, and their proportion to the population.

1932.	Births.		Deaths.		Marriages.	
	Number.	Annual rate per 1,000 of population.	Number.	Annual rate per 1,000 of population.	Number.	Annual rate per 1,000 of population.
1st quarter ...	13,596	18·3	13,189	17·7	3,181	4·3
2nd „ ...	14,758	19·8	11,242	15·1	3,181	4·3
3rd „ ...	14,779	19·9	8,882	11·9	3,478	4·7
4th „ ...	13,034	17·5	9,644	13·0	3,245	4·4
Total for year 1932	56,167	18·9	42,957	14·4	13,085	4·4

Population of the Free State estimated to mid-1932 :—2,974,000.

1932.	Births.		Deaths.		Marriages.	
	Number	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.
1st quarter—						
Total rural districts	8,687	16·7	8,939	17·1		
Total urban „	4,909	22·1	4,250	19·1		
Dublin City „ ...	2,518	24·2	2,036	19·6		
Cork Co. Borough	417	21·3	396	20·2		
2nd quarter—						
Total rural districts	9,391	18·0	7,852	15·1		
Total urban „	5,367	24·2	3,390	15·3		
Dublin City „ ...	2,745	26·4	1,563	15·0		
Cork Co. Borough	446	22·7	323	16·5		
3rd quarter—						
Total rural districts	9,189	17·6	6,077	11·7		
Total urban „	5,596	25·2	2,805	12·6		
Dublin City „ ...	2,877	27·7	1,323	12·7		
Cork Co. Borough	424	21·6	258	13·1		
4th quarter—						
Total rural districts	8,376	16·1	6,428	12·3		
Total urban „	4,658	20·1	3,216	14·5		
Dublin City „ ...	2,363	22·7	1,614	15·5		
Cork Co. Borough	395	20·1	266	13·6		

Note.—Dublin City rates based on 1932 population estimate; the others on census population, 1926.

No. V.—GREAT BRITAIN AND IRELAND.**SUMMARY of BIRTHS, DEATHS and MARRIAGES, in the Year 1932.**

(Compiled from the Quarterly Returns of the respective Registrars-General.)

Countries.	[000's omitted.]		Births.	Per 1,000 of popula- tion.	Deaths.	Per 1,000 of popula- tion.	Mar- riages.	Per 1,000 of popula- tion.
	Area in statute acres.	Popula- tion middle 1932, estimated						
England and Wales ... }	37,340	No. 40,201	No. 613,972	Ratio. 15·3	No. 484,083	Ratio. 12·0	No. 306,132	Ratio. 7·6
Scotland ...	19,462	4,880	91,001	18·6	66,047	13·5	33,177	6·8
Northern Ire- land ...	3,488	1,256	25,184	20·0	17,817	14·2	7,113	5·7
Great Britain and North- ern Ireland }	60,290	46,337	730,157	15·8	567,947	12·3	346,422	7·5
Irish Free State ... }	17,254	2,974	56,167	18·9	42,957	14·4	13,085	4·4

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BRITISH RAILWAYS SINCE THE WAR.

By K. G. FENELON, M.A., Ph.D.

[Read before the Royal Statistical Society, March 21st, 1933, the PRESIDENT,
the RT. HON. LORD MESTON OF AGRA AND DUNOTTAR, K.C.S.I., LL.D.,
in the Chair.]

THE CHAIRMAN, in introducing Dr. Fenelon, said that no one could level against the Society the charge of not being up-to-date with regard to modern problems. At the present moment, among the country's domestic difficulties probably none pressed more gravely upon the nation than the present position and future outlook of the great railway system. Not only was the railway system the backbone of national transport; not only did it represent an enormous amount of national wealth sunk irretrievably in the system itself, but when looked at from the purely human aspect, it was a question of the gravest importance to a vast number of people who depended for their living upon the operation of the railways. There was a deplorable accumulation of unhappiness as the result of the disappearance of the yield to small investors that would formerly have been regarded as so constant and so assured from this great system.

Whether the railways could be helped by any method of State control, by any tightening up of the imperfectly controlled cut-throat competition to which they were at present exposed, whether they could be helped by scientific development and the results of advanced research into the methods of transport and locomotion, or whether there were any other remedies available that would tide the industry over this temporary period of depression, were among the problems which disturbed most of us to-day. The paper to be read to the Society was by a very distinguished expert, Dr. Fenelon, and the Chairman ventured to think that when the Society had heard his

analysis of the situation, all concerned would be in a better position to face those problems.

DR. FENELON then read a summary of the following paper.

Great Britain possesses a very extensive network of railways which amounts to 20,408 route miles. This reduced to single track equals 37,199 track miles, or with sidings 52,837 miles. In comparison the total road mileage of Great Britain is 179,286 miles, of which about 26,000 miles consist of Class I roads, 15,000 are of Class II and some 137,500 are unclassified. Of the unclassified road mileage, however, a very large proportion consists of residential streets in towns and of country lanes. In 1926-27 some 68,512 miles of unclassified roads were "scheduled" for Government grants as possessing a measurable degree of traffic value, so in all, therefore, it may be said that there are approximately 110,000 miles of road in this country which are used for traffic purposes.

Inland waterways in Great Britain are comparatively less important and the total mileage is only approximately 4,050 miles. There are thus roughly five route miles of railway for every mile of inland waterway and five miles of traffic-used highway for every mile of railway.

Nearly two-thirds of the railway route mileage consists of double track or of more than two tracks, the figures being 10,941 miles of double track, 1,802 of more than two tracks and only 7,665 miles of single track.

Out of the total 20,408 route miles, 20,260 are of standard gauge (4 ft. 8½ in.) and the remainder, amounting to less than one per cent., is of narrow gauge. About 71 route miles are of 1 ft. 11½ in. gauge, mainly in Wales, and about 21 miles are of 2 ft. 3 in. gauge. There are approximately 46 route miles of railway per 100,000 inhabitants in Great Britain and about 20 route miles per 100 square miles.

There has only been a slight increase in railway route mileage since the war. In 1913 the route mileage of British railways was 20,246 miles and it is now but 162 miles more, namely, 20,408 miles. There is now no considerable scope left for further railway construction in this country apart from duplications of tracks, short extensions into new industrial regions or branches into new suburban areas. To some extent these developments will probably be offset by the abandonment of unremunerative branch lines. Road transport development has rendered redundant many branch lines in areas of light traffic. Between January, 1923, and July, 1931, indeed, the four grouped railways closed 82 branch lines, totalling 711 miles, to passenger traffic, though a large proportion of this mileage is still worked for goods traffic.

Since the war, British railways have had to face an entirely new set of conditions which are in marked contrast to those of pre-war days. The first phase in the post-war history of our railways was that in which they were concerned in recovery from war conditions. During the war and for a short time thereafter, the railways were used for the free conveyance of troops and materials, including munition factory requirements and output. Maintenance and repairs had been reduced to the minimum, and indeed much railway material, including rolling stock and even permanent way, had been sent overseas to the war areas. These arrears had to be made good before the railways could hope to recover their pre-war efficiency. Eventually the railways obtained compensation amounting in all to sixty million pounds for war-time arrears of maintenance and repairs and other consequential damages, but it can be said that they made no excess profits out of their country's need.

In 1919 the railway strike gave a set-back to recovery and provided the first impetus to the development of competitive road transport. In 1921 the comprehensive Railways Act of that year marked the return of the railways to ordinary commercial management and the opportunity was then taken by the Government to readjust the relations of the railways to each other, to their employees and customers and to the State. The Act provided for the compulsory amalgamation of numerous independent companies into four large groups, and in 1923 the greater part of the railway system of the country was reorganized as a result of these combinations. In this way 120 railway companies out of a total of some 214 separate companies existing in 1921 were amalgamated into one or other of the groups. Between them they own nearly 95 per cent. of the total route mileage of the country, and their capital represents about 90 per cent. of the total railway investment of the country. Of the 90 odd companies excluded from the grouping, 44 are jointly owned or leased by the groups, seven or eight are suburban passenger railways, about 20 are narrow-gauge railways, and of the remainder some are tramways or small local lines.

The route mileage of the four groups amounted in 1931 to 19,347 miles and was distributed as shown in the following table :

TABLE I.
Route mileage, 1931.

S.R.	2,192 miles 59 chains
G.W.R.	3,803 miles 65 chains
L.M.S.R.	6,962 miles 69 chains
L.N.E.R.	6,387 miles 34 chains

The next table shows the capital of the four groups together with the grand total for all railways. The total capital expended exceeds the capital receipts from shareholders, etc., by about £46,500,000, made possible by the use of accumulated reserves set aside for specific purposes and Savings Banks Deposits, benevolence funds, etc., which have been invested in the Railway instead of in outside concerns. It was recently stated before the Railway Wages Board that the replacement value based on existing assets is about 46 per cent. in excess of the capital expended.

TABLE II.
British Railway Capital.

	Total Capital Receipts.	Railway Capital expended.	Total Capital expended.*
	£	£	£
L.M.S.R.	429,776,826	384,152,206	452,281,721
L.N.E.R.	330,975,478	286,379,847	347,085,421
G.W.R.	167,258,455	145,482,083	175,630,028
S.R.	156,027,926	139,101,289	159,389,717
Total (four groups) ...	£1,084,038,685	£955,115,425	£1,134,386,887
Grand Total (all railways)	£1,187,479,062	£1,068,593,533	£1,234,037,483

* Includes capital spent on ancillary services and subscriptions to other companies.

In Table III the distribution of the capital among the different items is shown separately for each of the four groups, and in the last column the percentage which these bear to the total capital expenditure is indicated. The figures given relate to 1930.

The most noticeable features of railway capital are—

- (1) The great amount of capital necessarily involved in the provision of a railway system.
- (2) The fixed nature of the investment, which once expended is largely tied to a particular route, and
- (3) The preponderance of overhead charges in total costs.

From Table III it will be seen that 69·2 per cent. of the total capital, or 82·2 per cent. of the capital invested in the permanent way, stations, equipment, etc., representing the railways proper, as distinguished from works and ancillary businesses, has been incurred on the permanent way and buildings. Rolling stock accounts for 12·9 per cent. of the capital expenditure, and docks, wharves and harbours for 5·7 per cent.

The grouping did not by any means eliminate competition

between the companies. British railways had grown up in a haphazard fashion and it was, therefore, impossible to effect a geographical redistribution of the companies into definite areas exclusive to each. Recently, however, attempts have been made to introduce schemes of traffic pooling in competitive areas so as to secure the logical completion of the amalgamations effected in 1923. Somewhat similar agreements had been effected prior to the war in certain

TABLE III.
Distribution of Capital Expenditure.

	L.M.S.R.	L.N.E.R.	G.W.R.	S.R.	Total (Four Groups).	Percentage of Total Capital.
	£	£	£	£	£	
Permanent way and buildings...	311,845,886	232,096,318	120,687,541	119,220,624	784,750,369	69.2
Rolling stock ...	61,952,450	46,734,802	20,806,185	17,284,485	146,777,922	12.9
Manufacturing and repair works ...	9,955,443	5,949,867	3,952,857	2,437,937	22,296,104	2.0
Lines under construction, leased lines, etc.	398,427	698,860	35,500	158,243	1,291,030	0.1
Total Capital expended on railway ...	£384,152,206	£286,379,847	£145,482,083	£139,101,289	£955,115,425	84.2
Docks, harbours and wharves ...	10,211,776	25,102,864	20,946,536	8,707,348	64,971,524	5.7
Steamboats ...	3,471,451	2,975,073	471,094	2,765,938	9,683,556	0.9
Hotels ...	5,172,709	2,640,115	181,334	1,627,559	9,621,717	0.8
Canals ...	5,949,632	1,313,118	781,668	77,700	8,122,118	0.7
Road transport (vehicles, horses, garages, etc.) ...	2,616,222	1,211,462	1,271,894	345,903	5,445,481	0.5
Electric power stations ...	2,024,835	440,651	516,696	685,863	3,677,045	0.3
Lands, etc., not forming part of railway or stations ...	15,292,080	12,240,382	3,139,640	5,668,305	36,340,407	3.2
Lines jointly owned ...	6,636,546	10,349,775	322,589	342,820	17,651,710	1.6
Subscriptions to other companies	10,321,508	3,238,711	2,451,980	—	16,012,199	1.4
Miscellaneous ...	6,429,756	1,184,423	64,534	66,992	7,745,705	0.7
Total Capital Expenditure ...	£452,281,721	£347,085,421	£175,630,028	£159,389,717	£1,134,386,887	100.0

areas, *e.g.* Edinburgh-Glasgow, but until recently public opinion ran strongly against such schemes on the grounds that they were monopolistic in character. The Railways Act of 1921 indeed prohibited the amalgamated companies from entering into agreements with each other for the allocation of traffic or the pooling of receipts unless the consent of the Minister of Transport was obtained. Conditions now, however, have changed and opinion in 1932 was less hostile towards railway combination, since road transport has broken down the former partial monopoly of the railways. In May

last the Minister of Transport appointed a committee to consider a pooling scheme proposed by the L.M.S.R. and the L.N.E.R. In August the proposal was sanctioned, but as yet there has not been sufficient time for the results of the pooling to manifest themselves. In September sanction was sought for a similar traffic pool between the L.M.S.R. and the G.W.R., and also for a tripartite pool between the L.N.E.R., the L.M.S.R. and the G.W.R. for traffic common to all three. The decision of the Minister has yet to be announced on these two schemes.

It is claimed in favour of traffic pooling that it would eliminate much costly expenditure on competitive facilities and at the same time would increase public facilities. Tickets would become inter-available over different routes; time-tables could be dove-tailed; advertising and canvassing expenses would be reduced; unnecessary train mileage could be eliminated and terminal stations might be combined where convenient. On the whole it would seem that traffic pooling should be to the advantage of railway users provided reasonable safeguards for the benefit of the public and traders were introduced. It should enable better facilities to be given and, of course, it would save much unnecessary expense at present involved in providing duplicated facilities.

The alternative to pooling would have been the complete fusion of the four groups into one great concern, but in a country of dense traffic such as Great Britain there would be great difficulties in the administration and organization of such a huge concern. Even as it is, in the case of the two largest groups there have been difficulties in so organizing the concerns that local officials might have sufficient power and authority to deal with local problems and at the same time to secure the advantages of centralization. Probably the best solution of this problem would be to adopt the divisional or area system of organization in respect of commercial and working operations, with departmental management at the top. In manufacturing businesses of a large size the functional type of organization has been found most satisfactory, but the far-flung and special characteristics of the railway industry necessitate the adoption of a special type of organization.

The Railways Act, 1921, also introduced fundamental and far-reaching changes in the charging powers of the railways. The Railway Rates Tribunal was established with its very extensive powers of regulating rates, fares and other charges. The principle of the "Standard Revenue" was introduced as the *modus operandi* of regulation in place of the old, inelastic system of maximum rates. On the 1st January, 1928, the long-deferred "Appointed Day" prescribed in the Act came to pass and the old eight statutory

classifications for goods and merchandise were replaced by a new classification of twenty-one classes. Numerous other alterations regarding charges were also brought into operation on that date. A prodigious amount of labour was expended in framing the new classifications, but changing circumstances have rendered much of this work altogether useless. The original aim of the new classification had been to reduce the number of exceptional and special rates, which ran into many millions, but road competition and trade depression rendered the continuance of a policy of granting numerous exceptional rates essential.

During the past few years, road competition has even tended to break down the old-established system of differential charging, and tentative experiments have been made towards the substitution of "truck load" and "flat rate" charges in place of a tariff based on the value of the articles transported.

In the post-war period the main changes in the level of rates were a 20 per cent. increase in coal traffic rates and a 25 per cent. to 60 per cent. increase in various merchandise rates in January, 1920, over pre-war rates. In September of the same year nearly all freight rates for merchandise were increased to 100 per cent. over pre-war rates. Then in 1923 freight rates were reduced to about 50 per cent. above pre-war levels, but from the 1st February, 1927, an increase to about 63 per cent. above pre-war was made. In 1928 a slight decrease resulted from the introduction of the new standard rates, bringing them to something like 60 per cent. above pre-war rates. The position, however, is complicated by the existence of numerous exceptional rates lower than the ordinary class rates. Even in 1928 two-thirds of the charges were "exceptional," and the proportion since then has steadily increased, thus reducing the average level of rates in practice.

Passenger fares were increased by 50 per cent. in 1917 and by a further 16½ per cent. in 1920, making 75 per cent. in all above pre-war fares. In 1923 they were reduced to a level of 50 per cent. above pre-war fares, where they still remain. In practice, however, the average fare has been reduced to about ¾d. per mile through the great increase in the number of cheap fares. The passenger tariff has become extraordinarily complicated owing to the number and variety of special fares and there is now an urgent need for its simplification.

Comparing pre-war and post-war railway expenditure, there has been a great increase in the level of expenditure. Formerly it took a railway about ten years to turn over its capital, now it takes but six or seven. The main causes of this increased expenditure have been the rise in the cost of materials, and more important still

the increase in labour costs. According to evidence given before the National Wages Board, the average wage of a railwayman in 1914 was 28s. 5d. per week, and in 1932 it was 61s. 7d., an increase of 117 per cent., or, allowing for the rise in the cost of living, by 43 per cent., an increase in real wages of 51 per cent. In 1913 about 51 per cent. of the receipts of the companies, after allowing for costs of materials and miscellaneous charges, went to wages and salaries and 49 per cent. to capital. In 1931 the proportions were 75 per cent. to wages and salaries and 25 per cent. to capital.

Since 1923 working expenses have been considerably decreased as a result of economies coupled with reductions in the prices of materials. Since 1928 reductions have also been effected in wages, and the effect of the reductions obtained in 1931 gave a saving to the companies of £3,660,000 per year.

In 1923 the total expenditure of the four groups was about 157 million pounds. By 1931 it had been reduced to 129 million pounds, representing a saving of 18 per cent. During 1932 there have been further substantial economies. Railway expenditure, however, is relatively inelastic, since much of it is independent of the traffic and so it has not been possible to obtain a reduction equivalent to the falling off of receipts. Many of the economies obtained have been realized without a reduction in efficiency and are likely to be permanent. The railways, therefore, are well placed to obtain immediate benefits from any revival in trade.

TABLE IV.
Railway Expenditure. (Four Grouped Companies.)

£m.

Year.	Maintenance.		Loco. Running.	Traffic Expenses.	Other Expenses.	Total Expenses.	
	Way and Works.	Rolling Stock.				£m.	%
1913	11.3	13.0	16.3	22.4	9.0	72.0	--
1923	23.5	27.6	38.3	52.1	15.4	156.9	100
1924	23.0	27.4	39.3	52.9	15.1	157.7	101
1925	22.6	27.2	38.3	52.8	15.1	156.0	99
1926	19.4	23.4	39.0	48.5	14.9	145.2	93
1927	21.2	27.2	37.5	51.4	14.5	151.8	97
1928	21.1	25.4	34.2	50.4	13.9	144.7	92
1929	21.0	26.0	33.9	48.7	12.9	142.5	91
1930	19.7	24.9	33.5	48.3	12.5	138.9	89
1931	18.1	22.4	31.3	45.0	12.3	129.1	82

In Table IV, above, it will be seen that there has been a steady decrease in expenditure year by year, apart from the apparent rise in 1927. The year 1926, owing to the General Strike and the Coal

Dispute, was, of course, in every way exceptional and the marked fall in expenditure that year was due to the special conditions. The total sum of 27·8 million pounds saved between 1923 and 1931 is a very impressive amount and reflects the strenuous efforts that have been made to reduce costs. Moreover, the savings have been obtained without any corresponding reduction in train-miles, which indeed actually increased by about 5 or 6 per cent. in the period.

In this and in many of the subsequent tables figures have been inserted for the year 1913, but statistical comparisons between this and the post-war years must only be made with care, owing to changes not only in the price level but throughout the whole industrial structure of the country.

In Table V the revenue of each of the four grouped companies is shown for each year since 1923, together with that of the constituent companies for 1913. Since 1928 the financial accounts of British railways have been prepared in an amended form, but statistics for 1927 were recompiled by the companies on the new basis, and in the table approximate adjustments have been made for the years 1923 to 1926. The figures are sufficiently reliable for comparative purposes though they cannot be regarded as absolutely accurate. It will be observed that railway revenue has fallen by 19 per cent. between 1923 and 1931, but the fall has been most severe since 1929. Revenue from parcels and similar traffic has fallen least and indeed has been remarkably well maintained. Revenue from passenger traffic, on the other hand, has fallen most severely. For the year 1932 the loss in gross receipts has been estimated at about 16 million pounds.

TABLE V.

*Railway Revenue. Receipts of four amalgamated companies
(L.M.S.R., L.N.E.R., G.W.R. and S.R.).*

Year.	Pas- sengers.		Parcels, etc.		Mer- chandise.		Coal.		Minerals.		Live- stock.		Sundry.		Total.	
	£m.	%	£m.	%	£m.	%	£m.	%	£m.	%	£m.	%	£m.	%	£m.	%
1913	41·3	—	9·1	—	30·6	—	22·2	—	8·8	—	1·2	—	0·9	—	114·1	—
1923	68·9	100	17·4	100	51·2	100	38·9	100	15·3	100	2·0	100	1·9	100	195·6	100
1924	70·2	102	17·0	97	49·6	97	36·6	94	15·8	104	2·0	101	1·8	98	193·0	99
1925	68·9	100	17·3	99	49·6	97	34·7	89	15·2	100	1·9	95	1·8	96	189·4	97
1926	60·6	88	16·8	97	45·6	89	23·4	60	12·5	82	1·8	90	1·6	86	162·3	83
1927	63·5	92	17·6	101	52·1	102	36·0	94	16·6	109	1·9	97	1·6	89	189·9	97
1928	62·1	90	17·5	100	49·4	96	33·6	86	15·3	100	1·9	96	1·7	92	181·5	93
1929	60·0	87	17·6	101	49·0	96	36·5	94	16·2	106	1·8	92	1·7	91	182·8	93
1930	57·0	83	17·5	101	45·5	89	34·6	89	14·6	96	1·8	89	1·6	87	172·6	88
1931	52·4	76	16·8	96	41·8	82	32·1	83	12·3	80	1·6	77	1·5	80	158·5	81

Note.—Percentages are calculated on the actual amounts and not on the approximate figures given in the table.

By deducting the amount of railway expenditure given in Table IV from the railway revenues shown in Table V, we obtain the net revenues earned by the railways proper, but to this has to be added the net revenue obtained from ancillary enterprises such as docks, hotels, rents, etc. In Table VI are shown the net revenues of the four groups obtained from the railway proper and the ancillary services. It will be seen that the total net revenues have fallen from 45·6 million pounds in 1923 to 32·8 million pounds in 1931, while for 1932 the estimated net revenues are but 26 million pounds. This net revenue represented 4·41 per cent. on all capital in 1913, 4·40 per cent. in 1923, 4·17 per cent. in 1929, 3·48 per cent. in 1931, while for 1932 it has been estimated to represent only about 2·25 per cent. The drop in net revenue has greatly reduced the earnings of ordinary stocks, since these have had to bear the brunt of the fall. The average earnings on ordinary stocks were 5·55 per cent. in 1913, 3·27 per cent. in 1929, 2·23 per cent. in 1930 and 0·95 per cent. in 1931, while for 1932 they will practically disappear.

The proportion of railway capital going without any return in 1913 was 0·61 per cent., in 1929 3·31 per cent. and in 1931 10·03 per cent.

TABLE VI.
Net Revenue. (Four Grouped Railways.)

£m.

Year.	Railway net Revenue.	Other Revenue.*	Total net Revenue.
1913	42·1	3·1	45·2
1923	38·7	6·9	45·6
1924	35·3	6·0	41·3
1925	33·4	5·2	38·6
1926	17·1	3·5	20·6
1927	38·1	4·5	42·6
1928	36·8	4·2	41·0
1929	40·3	4·7	45·0
1930	33·7	4·0	37·7
1931	29·4	3·4	32·8

* Includes net revenue from joint lines, interest from other undertakings, docks, hotels and other ancillary enterprises.

The Volume of Traffic. The combined influence of trade depression and road transport competition have been responsible for the great fall in revenue since the war. The volume of traffic has been affected to a considerable extent by variations in prosperity during this period. The year 1919 and part of 1920 were boom years; then after the collapse of this boom, there was a gradual improvement from 1921 to 1924. In 1923-24 the occupation of the Ruhr

stimulated coal production in Britain, and this is clearly reflected in coal traffic. But after 1924 there was a decline up to 1926, and in that year the General Strike and the coal dispute proved disastrous for the railways. Recovery, however, was marked up to 1929, and then the unexampled world depression in trade brought the railways to their lowest ebb in the post-war period.

Since 1921 the railways have suffered severely from the chronic depression in the old pre-war export industries. These are the heavy industries such as coal-mining, iron and steel production, ship-building, etc., which provide a type of traffic well suited to rail transport. From Table VII it will be seen that the tonnage of coal,

TABLE VII.

Coal, Coke and Patent Fuel. (All Railways : excluding free-hauled.)

1913	...	...	...	225,601,127	tons
1920	...	...	...	181,242,139	"
1921	...	...	...	128,291,861	"
1922	...	...	...	200,102,316	"
1923	...	...	...	222,234,412	"
1924	...	...	...	209,160,559	"
1925	...	...	...	193,661,991	"
1926	...	...	...	114,098,398	"
1927	...	...	...	195,769,382	"
1928	...	...	...	187,328,581	"
1929	...	...	...	207,130,109	"
1930	...	...	...	193,288,726	"
1931	...	...	...	173,680,226	"

coke and patent fuel carried by British railways was 225,601,127 tons in 1913. In 1923 the occupation of the Ruhr gave a considerable stimulus to the British coal trade, but even then the tonnage handled did not reach the standard of 1913, falling short by well over three million tons. The year 1929 was a good year, but the tonnage carried was only 91·8 per cent. of that in 1913. The depth of the depression in the coal trade since 1929 is indicated by the falling off of 33½ million tons by 1931. Coal traffic is practically immune from road competition and the losses are obviously due to the depression in the coal-mining industry. This in turn is the result of general trade depression, the loss of export markets and the increasing use of oil fuels in place of coal. There has been some loss of traffic to coastwise shipping, and recently Sir Ralph Wedgwood in evidence before the National Wages Board stated that the railways had lost the carriage of two million tons of coal from the Midlands to the South in consequence of the competition of coal shipped coastwise from Northumberland and Fife. Shipping freights, he stated, are now 16 per cent. below the pre-war level owing to the severe depression in the freight market. Shallow-draught motor coasters are now being employed by British coastal shipping com-

panies and, according to a recent articles in *The Times*, the use of these craft has remade Norwich as a seaport within a year or two. No less than 30,000 to 40,000 tons of sea-borne coal a year are now being carried into Norwich, which until comparatively recently rarely brought in a cargo by water.

Mineral traffic other than coal also fell off greatly during the post-war period as compared with the 1913 level, and here again the cause is that of depression in the heavy industries. As is shown in Table VIII, there has been a decline in this traffic from about 71 million tons in 1913 to approximately 47 million tons in 1931. The figures are not strictly comparable, as the basis of the returns was altered after 1925, but they serve to give a sufficiently exact idea of the changes which have taken place.

TABLE VIII.

General Merchandise and Minerals other than Coal, Coke and Patent Fuel. (All Railways.)*

Year.	Merchandise.	Minerals.
1913	67,755,470 tons	71,067,357 tons
1920	68,687,092 "	68,124,664 "
1921	50,527,878 "	39,061,544 "
1922	52,844,446 "	48,678,846 "
1923	58,979,959 "	62,052,237 "
1924	60,943,377 "	65,392,964 "
1925	59,739,284 "	62,549,965 "
1926	53,439,125 "	48,059,504 "
1927	60,242,571 "	65,837,362 "
1928	57,214,719 "	61,585,504 "
1929	57,575,244 "	64,873,390 "
1930	53,225,830 "	57,846,551 "
1931	47,570,848 "	47,129,074 "

* After 1925 "Merchandise" excludes Classes 1 to 6 and "Other Minerals" becomes "Minerals and Merchandise" (Classes 1 to 6).

Since the war there has been a considerable expansion in the lighter industries of Great Britain, but these provide less traffic for the railways and the traffic is of a kind more easily diverted to the road. Moreover, these industries have been located for the most part near to their principal markets. The new tariffs on imports may also tend to localize industry besides reducing the amount of traffic carried by rail, the effect of which will be additional to the influences prevailing in 1931.

General merchandise, as will be seen from Table VIII, aggregated 67½ million tons in 1913, but after 1920 it has not reached 61 million tons. In this case obviously road transport competition and trade depression have combined to reduce the volume passing over the

railways. Between 1929 and 1931 there was a drop of 10 million tons.

Detailed figures for passenger traffic are given in Tables IX and X. It is best to separate passenger traffic carried by the London Tubes and Metropolitan District Railway from that carried by the other systems, since obviously special conditions apply in the case of local London traffic and the distances travelled on the average are shorter. Between 1920 and 1931, apart from traffic on the London

TABLE IX.

*Number of Passengers carried on British Railways * (excluding Season-Ticket Holders).*

Year.	First Class.	Second Class.	Third Class.	Workmen.	Total.
1913	23,495,412	10,255,028	756,202,020	212,746,414	1,002,698,874
1920	34,487,569	5,632,897	822,804,522	392,700,010	1,255,624,998
1921	23,084,481	4,546,489	680,390,357	261,101,551	969,122,878
1922	19,137,010	4,440,950	665,920,718	255,966,713	945,465,391
1923	20,011,825	4,055,268	709,087,387	269,132,846	1,002,287,326
1924	20,084,936	2,928,810	711,133,206	271,529,711	1,005,676,663
1925	19,497,131	2,773,097	697,833,327	264,739,897	984,843,452
1926	17,015,926	2,433,805	591,491,553	216,757,843	827,699,127
1927	17,883,440	2,475,497	645,969,986	236,799,497	903,128,420
1928	17,504,348	2,362,688	639,405,142	247,683,288	906,955,466
1929	17,244,920	2,217,554	657,288,430	252,110,794	928,861,698
1930	16,454,389	2,306,689	641,867,158	241,386,298	902,014,734
1931	14,354,255	2,055,509	609,254,601	223,124,257	848,788,622

* Excludes London Tubes and Metropolitan District Railway.

TABLE X.

*Season Tickets (equivalent Number of Annual Tickets).**

Year.	First Class.	Second Class.	Third Class.	Total.
1913	102,903	77,149	369,517	549,569
1920	167,642	100,722	661,467	929,831
1921	139,163	93,122	615,223	847,498
1922	135,074	89,845	621,611	846,530
1923	129,858	73,825	619,643	823,326
1924	121,101	49,994	615,478	786,573
1925	115,214	48,748	619,072	783,034
1926	102,920	45,357	572,964	721,241
1927	97,559	44,433	579,137	721,129
1928	90,548	44,158	570,277	704,983
1929	86,131	43,329	568,549	698,009
1930	80,615	42,098	570,539	693,252
1931	72,376	38,819	552,791	663,986

* Season tickets available for less than 12 months equated to equivalent number of annual tickets. Excludes London Tubes and Metropolitan District Railway.

Tubes and Metropolitan District Railway, there was a decrease of almost one-third in the number of passengers carried other than season ticket-holders. The decline in first-class passengers is very marked, the number in 1931 being but 41·6 per cent. of that in 1920. Competition from private motor-cars, trade depression and probably the increased comfort of third-class carriages readily explain this decline. Second-class travel has shown an even greater decrease, to about 38 per cent. of that in 1920, but there has been a definite tendency to restrict the provision of second-class carriages to certain boat trains and to certain suburban districts around London. Second-class travel now accounts for less than $\frac{1}{2}$ per cent. of ordinary travel (excluding workmen's tickets).

The decrease in the number of workmen's tickets is primarily due to trade depression and the figures reflect the varying degrees of prosperity during the post-war years. To some extent there has probably been some loss to road competition, but this cannot be very great, as few motor-bus concerns offer reduced fare facilities to workmen. The railways, it should be stated, do not make much profit out of workmen's fares, as the charges are so low, but there is a legal obligation on them to provide reasonable facilities.

Road competition with other forms of passenger traffic has been most severe in regard to short-distance traffic. In many districts, indeed, road competition has caused a very heavy fall in short-distance railway traffic. During the last three or four years, however, trade depression would seem to be the more important factor in the further fall in such traffic. This conclusion is borne out by the fact that the heaviest falls have been in the older industrial areas, such as Tyneside and Lancashire.

Season tickets for statistical purposes are reduced to an equivalent number of annual tickets, since in practice they are issued for one week and two weeks and for any period over one month. It is usual also to suppose that one annual season ticket is on the average equivalent to 600 journeys. The figures in Table X show that there has been a marked reduction in the number of season tickets issued in 1931 as compared with 1920, though the decline is not so great as in the case of ordinary passengers, being about 29 per cent. as compared with about 32 per cent. The decline in first-class season ticket travel since 1920 is nearly 57 per cent., second-class about 61 per cent. and third-class about 16 $\frac{1}{2}$ per cent. These reductions have no doubt been in part due to trade depression, but the main cause has been road competition. This is demonstrated by the continuous falling off since 1920, and in this connection private motor-cars have been responsible for large traffic losses to the railways.

Parcels and miscellaneous traffic carried by passenger train cannot very well be measured in physical quantities, since they vary so much, but, as was shown in Table V, revenue from this type of traffic has been very well maintained, despite road competition and trade depression. The figures demonstrate that the railways can hold their own where they give a high quality of service at a high rate of speed. Changing trends in trade and the modern demand for a rapid service also no doubt are in part responsible for the popularity of these services.

Turning now to consider the traffic on the London Tube Railways and the Metropolitan District Railway, it will be seen from Table XI that these railways have not suffered from loss of traffic to anything like the same extent as have the main line companies. The

TABLE XI.

Passenger Traffic on London Tubes and Metropolitan District Railway.

Year.	Ordinary Tickets.	Workmen.	Season Tickets.*
1913	153,628,754	42,937,893	34,640
1920	256,955,219	66,434,018	81,226
1921	214,588,406	45,712,228	81,248
1922	205,579,744	43,636,981	77,260
1923	192,110,538	41,168,556	70,340
1924	191,782,360	38,751,004	64,501
1925	203,892,903	43,844,559	68,195
1926	197,882,244	43,402,850	66,918
1927	221,430,051	50,180,686	72,662
1928	234,386,812	54,513,098	79,233
1929	250,014,213	57,336,621	82,893
1930	256,039,576	59,231,390	85,779
1931	250,190,424	57,374,143	85,761

* Equivalent number of annual tickets.

number of ordinary passengers, workmen's tickets and season tickets, except for the year of the General Strike, have shown a continuous increase from 1924 to 1930. The figures illustrate the greater prosperity of London as compared with the industrial North, and would seem to indicate that after 1923 London recovered definitely from the post-war slump. After 1930, however, trade depression caused a heavy drop in traffic. According to the recent report of the London Underground Group, the loss in traffic since 1930 has been mainly in casual and pleasure traffic, *e.g.* at Christmas time, the summer holiday months, Bank Holidays and week-ends. It would appear, therefore, to be largely due to the necessity for economy on the part of those who formerly had a surplus for pleasure travel. In 1932 some 2,236 million passengers were carried on the railways, buses and trams of the Underground

Group as compared with 2,283 million in 1931. This is a decrease of about 2 per cent.; as compared with 1930 the decrease is about 3 per cent.

Receipts from passenger traffic for all railways in Great Britain, including the London Tubes and Metropolitan District Railway, are shown in Table XII. It will be noticed that receipts in 1931 were but a little more than two-thirds of those in 1920 and that they represented the lowest point reached in the post-war period up to that year. In reading the table, however, it should be borne in mind that passenger fares were reduced from 75 per cent. to 50 per cent. over pre-war in January, 1923.

TABLE XII.

Receipts from Passenger Traffic. (All Railways, including London Tubes and Metropolitan District Railway.)

Year.	Ordinary.	Season.	Workmen	Total.
	£	£	£	£
1913	38,795,977	4,771,950	1,663,150	45,231,077
1920	74,789,574	11,091,050	4,185,960	90,066,584
1921	69,249,464	11,967,422	4,253,663	85,470,549
1922	66,490,830	12,051,571	4,216,100	82,758,501
1923	61,218,274	11,667,367	4,112,119	76,997,760
1924	63,282,705	11,075,990	4,124,055	78,482,750
1925	61,835,772	11,140,906	4,115,577	77,092,255
1926	54,540,977	10,575,907	3,512,944	68,629,828
1927	57,829,100	10,649,181	3,818,923	72,297,204
1928	56,622,238	10,464,928	4,009,474	71,096,640
1929	54,564,494	10,322,606	4,174,388	69,061,488
1930	51,656,993	10,085,089	4,094,036	65,836,118
1931	47,348,790	9,750,343	3,869,935	60,969,068

The decreased volume of passenger traffic on the various railways has taken place despite considerable reductions in average fares. For the four group railways, receipts from passenger traffic of all kinds fell in 1930 to 83 per cent. of that in 1923, but the number of passenger journeys in the same period had only fallen to 88 per cent. of that in 1923, while the average distance travelled increased from 13·96 miles in 1923 to 15·32 miles in 1930.

The following tables (Tables XIII and XIV) show the proportion of passenger journeys and fares distinguished between full fares, reduced fares and workmen's tickets. In both tables season tickets are excluded as well as journeys on the London Tubes and Metropolitan District Railway.

During the post-war period the vigorous competition of the new mechanical road transport has completely broken down the regulated monopoly enjoyed by the railways in pre-war days. The first

TABLE XIII.
*Passenger Fares. Percentage of total Passenger Receipts.**

Year.	Full Fare.	Reduced Fares.	Workmen's Fares.
1926	61.72	32.73	5.55
1927	52.98	41.35	5.67
1928	47.62	46.37	6.01
1929	41.47	52.09	6.44
1930	39.76	53.61	6.63
1931	35.60	57.55	6.85

* Excludes Season Tickets. Excludes London Tubes and Metropolitan District Railway.

TABLE XIV.
*Passenger Journeys. Percentage of Total.**

Year.	At Full Fares	At Reduced Fares.	At Workmen's Fares
1924	47.35	25.54	27.11
1925	42.60	30.42	26.98
1926	40.90	32.92	26.18
1927	34.24	39.52	26.24
1928	28.18	44.46	27.36
1929	23.34	49.49	27.17
1930	21.89	51.29	26.82
1931	20.17	53.49	26.34

* Excludes Season Tickets. Excludes London Tubes and Metropolitan District Railway.

important impetus to this competition was given in 1919, when the railway strike of that year served to demonstrate the possibilities of road transport. Just after the war also the disposal of surplus army vehicles provided the necessary supply of vehicles, while many ex-service men had been trained as motor lorry drivers. During the industrial upheaval of 1926 the railways again lost a considerable amount of traffic to the roads which has never been regained.

In 1928 the four groups obtained Road Transport powers from Parliament which permitted them to invest in road transport concerns and to operate services of their own on an extended scale. They had first sought such powers in 1921 and again in 1922, but the tardy grant of legislative powers made it difficult for the railways to obtain the full advantages of co-ordination. In the meantime road transport had been developed to an astonishing degree without regard to rail facilities. The application for legal powers in 1928, which was pursued with great determination, marks the recognition

of the fact by the railway companies that road transport had come to stay, whereas up to 1928 railwaymen tended to believe that they could regain their old supremacy. Now they have been driven to realize that road transport has established itself as a definite part of the transport facilities of the country and that in certain spheres it has definite economic advantages over rail transport. To some extent, however, road transport has been developed at the expense of the railways by other than economic considerations, *e.g.* relief works on roads. The economic position of long-distance road transport and the carriage of heavy traffic by road has still to be settled, and a step in this direction now appears imminent.

After obtaining their powers, the railway companies set afoot negotiations with various passenger road transport concerns, and very soon a large number of agreements were effected, so that now there is an interlocking of capital between the railways and the great majority of road passenger services. The railway companies did not attempt to start road passenger services of their own; indeed, on the contrary, they handed over practically all their own bus services to their associated road companies. Considerable difficulties, however, had to be surmounted before any considerable degree of co-ordination could be achieved, but much has already been done to develop inter-availability of tickets, through bookings, dovetailing of time-tables, substitution of motor-bus services for passenger trains on unremunerative branch lines, etc. More recently a further degree of co-ordination has been effected under the licensing system introduced by the Road Traffic Act, 1930.

In regard to goods traffic by road, the railway companies have proceeded on entirely different lines. There has as yet been little or no combination with established road hauliers, but the railways have extended their cartage areas and inaugurated new road services for the collection and delivery of merchandise and live-stock. Another important development foreshadowed by recent events is the partial substitution of mechanical vehicles in place of the familiar railway horse vans for collections and deliveries. Motor tractors of the "mechanical horse" or "Karrier-Cob" type have been adopted on a large scale with great success in certain areas. In Manchester, for example, it is intended to mechanize the cartage system completely at the new L.N.E.R. goods depot at Ardwick East. The conditions under which collections and deliveries are effected, however, differ considerably in different areas, and in other districts the use of horse vehicles will probably still prove more economical than mechanical vehicles. It is possible also that there is still scope for the improvement of horse-drawn vehicles, *e.g.* use of rubber tyres.

In the following table (Table XV) details are given of road vehicles owned by the railway companies. The decline in the number of passenger motor vehicles since 1928 is explained by the handing over of bus services to associated companies. Horse-drawn passenger vehicles have now practically disappeared, while since 1928 there has been a marked increase in the number of goods motor vehicles and tractors.

TABLE XV.
Railway-owned Road Vehicles.

Year.	Parcels and Goods Vehicles.			Passenger Vehicles.		Horses for Road Vehicles.
	Motor.	Horse.	Misc.	Motor.	Horse.	
1913	191	32,657	267	241	231	26,270
1920	817	33,718	261	182	119	21,428
1921	1,690	33,425	295	150	114	18,344
1922	1,947	32,658	253	154	92	17,916
1923	2,099	32,639	153	187	72	18,320
1924	2,122	32,424	77	217	57	18,795
1925	2,282	31,663	70	303	38	18,512
1926	2,501	32,338	71	282	38	18,444
1927	2,861	32,169	407	289	13	18,706
1928	3,298	32,067	496	358	11	17,700
1929	4,011	32,281	178	249	9	18,575
1930	4,387	32,150	370	215	1	17,546
1931	4,959	31,188	536	191	1	16,557

Important developments of recent years have been the inauguration of railhead services, the extension in the use of containers and the development of rural lorry services. In 1928 the railway companies had only 350 containers in use; in 1929 the number had risen to over 2,000; in 1930 there were 4,385, of which 1,178 were open and 3,207 were covered. In 1931 the number had still further increased to 2,354 open, 3,924 covered and 12 "roll-off" type, giving a total of 6,290 containers. The average tonnage capacity per container in 1931 was 3.33 tons as compared with 3.40 tons in 1930. There were 502 wagons specially allotted to container traffic in 1931 as compared with 310 in 1930. The container combines the mobility of road transport with the advantages of high speed and low rates for bulk traffic which are possible with rail transport. It is, therefore, not surprising that their popularity has increased so rapidly. The use of containers, however, involves the provision of crane power at stations, and this is not always available. The companies in order to meet this need are now developing the use of mobile cranes.

Railhead distribution likewise combines rapid transit in bulk

by rail, warehousing of goods at central depots and distribution in small lots as and when required by road.

These new forms of co-ordinated road-rail transport have been perhaps the most important development of railway transport during recent years and they give promise of great extension in the future. The railways have now become in a sense not merely carriers but retail distributors. The new services are especially well adapted to modern trends in British trading and they offer a means of meeting road competition in that form which has been most difficult to counteract, namely, the private fleets operated by manufacturers and distributors.

No statistics are available relating to the volume of goods carried by road hauliers and ancillary road users, but the recent publication of the First Annual Reports of the Traffic Commissioners, 1931-32, now makes it possible for the first time to obtain statistical details of the operation of motor buses and coaches. For the calendar year 1931 the number of operators of public service passenger vehicles with seating capacity of eight or more passengers, including Metropolitan Stage Carriages, was 6,434 and the number of vehicles owned was 46,230. The average seating capacity was 31 passengers and the total seating capacity available was 1,433,130 seats, or just slightly more than half that of railway passenger rolling stock (*i.e.* 52 per cent.).

The average receipt per passenger journey was 2·66*d.* as compared with 1*s.* 0·97*d.* on railways (excluding season tickets). Road passenger receipts aggregated £58,323,653, which is almost the same as the total receipts from railway passenger traffic, which amounted to £60,969,068.

The detailed figures relating to public service road passenger vehicles will be found in Tables XVI to XXI below. It should be mentioned, however, that these figures relate to the first year in which the returns have been made, and it is, therefore, possible that statistics have not been obtained from all operators, though the omissions should not be large.

TABLE XVI.

Public Service Road Vehicles. Passenger Journeys, 1931.

		Local Authorities.	Other Operators.	All Operators.
Stage	... ..	1,097,526,738	4,084,948,757	5,182,475,495
Express	... ..	149,029	32,672,352	32,821,381
Contract	... ..	3,786,609	46,501,445	50,288,054
All Services	... ..	1,101,462,376	4,164,122,554	5,265,584,930

TABLE XVII.

Average Receipt per Passenger Journey. (All Public Service Road Operators.)

Stage	...	...	...	...	2.34d.
Express	...	...	...	...	35.93d.
Contract	...	...	...	...	13.54d.
					<hr/>
All Services	...	...	...	...	2.66d.

TABLE XVIII.

Passenger Receipts, 1931. (All Public Service Road Operators.)

Stage	...	...	...	...	£50,571,613
Express	...	...	...	...	4,914,247
Contract	...	...	...	...	2,837,793
					<hr/>
All Services	...	...	...	...	£58,323,653

TABLE XIX.

Receipts from Parcels, Mails, Luggage and Dogs. (All Public Service Road Operators.)

Stage	...	...	...	...	£284,167
Express	...	...	...	...	6,689
Contract	...	...	...	...	14,650
					<hr/>
All Services	...	...	...	...	£305,506

TABLE XX.

Vehicle Miles. (All Public Service Road Operators.)

Stage	...	...	...	...	1,162,628,810
Express	...	...	...	...	102,848,169
Contract	...	...	...	...	53,297,966
					<hr/>
All Services	...	...	...	...	1,318,774,945

TABLE XXI.

Average Receipt per Vehicle Mile. (All Public Service Road Operators.)

Stage	...	...	...	...	10.50d.
Express	...	...	...	...	11.48d.
Contract	...	...	...	...	12.84d.
					<hr/>
All Services	...	...	...	...	10.67d.

Much less serious to the railways than road competition is that experienced from canals and inland waterways. During the post-war period canals, like the railways, have suffered from trade depression in the heavy industries and from road competition. It will be observed from Table XXII that there has been a marked decrease in recent years in the amount of traffic passing by canal as compared with that in 1920. Traffic on the Manchester Ship Canal is excluded from the table, since this is used by ocean-going vessels. In 1913 it

may be remarked canal traffic amounted to about 24 million tons. The proportion of canal traffic carried by the railway-owned canals is about 12 per cent.

Despite the general reduction in canal traffic, the recently amalgamated and reorganized Grand Union Canal has been able to show an increase in traffic, and it is possible that a few other well-situated canals may even yet be able to compete for certain types of bulk traffic on better terms than formerly with the railways. The motor-engine has not yet been adopted extensively on British canals, and provided the banks are strengthened by concrete piling, the mechanization of canals may yet in such cases become a practical proposition. The greatest difficulty, however, confronting the canals is to meet the modern demand by traders for speed in delivery of relatively small consignments. In regard to such traffic the railways are in a much better position.

In 1931 about 45·5 per cent. of canal traffic consisted of coal and coke, about 11·5 per cent. of building materials and 11 per cent. of agricultural produce and food-stuffs.

TABLE XXII.
*Canal Traffic in Great Britain.**

Year.	Railway-owned Canals.	Otherwise owned.	Total.
	Tons.	Tons.	Tons.
1920	2,293,929	14,011,027	16,304,956
1921	1,708,547	10,175,948	11,884,495
1922	1,885,830	12,708,547	14,564,377
1923	2,058,944	13,804,929	15,863,873
1924	2,183,933	14,272,046	16,455,979
1925	2,030,675	13,540,266	15,570,941
1926	1,712,716	11,249,524	12,962,240
1927	1,987,799	13,185,072	15,172,871
1928	1,863,152	12,710,685	14,573,837
1929	1,772,663	12,589,517	14,362,180
1930	1,693,905	11,541,879	13,235,784
1931	1,539,161	10,866,454	12,405,615

* Excludes Manchester Ship Canal.

The changing nature of Railway Merchandise Traffic. During recent years the competition of road transport and changes in the methods of internal trading in this country have forced the railways to cater more and more for traffic in small lots. Traders now demand and expect to receive special facilities for traffic passing in small consignments. Several distinct factors have combined to accentuate this tendency. Traders now work with smaller capital and shorter credit than in pre-war days; they have attempted to protect themselves from the effects of the falling price level since 1921 by carrying

small stocks. Fluctuations in demand have become more frequent; fashion changes, for instance, are now spread over a much greater part of the community than in pre-war days and the demand for novelties, new designs, and the like is now much more insistent than formerly. Retail traders, therefore, now carry stocks of a wider and more frequently changing variety in colour, size, pattern, shape, etc., but of each variety they carry only a small stock, relying on rapid transport facilities to replenish their stocks as need arises.

The railways, therefore, have had to supply facilities which would meet traders' requirements, especially as this type of service can be readily given by road transport competitors. It is noticeable that where the railways have been most successful in retaining their merchandise traffic has been precisely in those services which provide fast services for small lots. General parcels traffic by passenger train, as was shown earlier, has been very well maintained largely because the services provided are better than those given by road hauliers.

Merchandise traffic by goods train has definitely tended to go in smaller lots. This has been pointed out, for example, by Sir Josiah Stamp, who has said that "the number of consignments of handled traffic per ton appears to be approximately three times what it was before the war." * According to the recent Report of the L.M.S.R. there was a further increase of nearly 6 per cent. in 1932 as compared with 1931 in the number of consignments handled per ton of goods traffic.

In the following table (Table XXIII) statistics are given relating to carted traffic forwarded from certain railway depots in Manchester on one day in April. They show the remarkable increase which has taken place in the number of small consignments. The greatest increase has been in the number of very small lots—namely, those 28 lbs. or less in weight, of which the proportion in 1932 was more than double that in 1924.

TABLE XXIII.

Carted Traffic forwarded from certain Depots in Manchester. (One day in April.)

Year.	Tons.	No. of Packages.	No. of Con- signments.	Up to 28 lbs.	Up to 1 cwt.	Up to 3 cwt.	Up to 1 ton.
1924	642	14,658	4,562	11·8%	51·0%	79·0%	98·0%
1926	660	15,731	4,931	12·7	52·0	80·0	98·0
1930	740	17,378	5,440	22·0	57·0	83·0	99·0
1932	639	15,318	5,034	24·0	61·0	85·0	98·0

* *Journal, Institute of Transport*, Vol. 9, p. 494, July, 1928.

It has also been stated that one of the railway companies handled 27·3 million tons of merchandise in 94·9 million consignments in 1923, but in 1930 the number of consignments had increased to 104·2 million despite a decrease in tonnage handled to 25 million tons. This gives an average of 4·17 consignments per ton in 1930 as compared with 3·48 in 1923.

These changes in the nature of railway traffic have greatly increased the difficulty and expense of handling traffic. The tendency would seem to be general throughout the world and it has been very marked in the United States.

For certain types of traffic, however, there has been a trend in the opposite direction, but this is in connection with wholesale rather than retail distribution. Progressive firms have come to realize the advantages of bulk loading of commodities which formerly were usually sent in small lots. Notable examples of modern bulk loading are the carriage of milk, petrol, oil and other liquids in tank wagons, the carriage of grain in bulk in specially fitted vehicles, the bulk loading of bricks, steel sheets and ammonium sulphate, and the increasing use of containers.

Railway Rolling Stock. The variation which has taken place in the number of locomotives owned by British railways is shown in Table XXIV below.

TABLE XXIV.
Locomotives owned by the Railways of Great Britain.

Year.	Steam Locomotives	Electric Locomotives	Petrol Locomotives	Electric Motor-cars	Rail Cars other than Electric
1913	23,581	83	*	969	208
1920	24,620	84	3	1,337	134
1921	24,392	84	3	1,409	126
1922	24,236	81	3	1,452	113
1923	24,184	41	6	1,457	109
1924	24,240	42	6	1,542	103
1925	24,166	42	8	1,859	102
1926	23,995	42	8	1,949	96
1927	23,963	40	8	1,961	94
1928	23,617	40	9	2,157	134
1929	23,404	40	10	2,353	172
1930	22,751	40	7	2,416	170
1931	22,325	40	8	2,466	168

* Figures not available.

The number of steam locomotives has decreased by nearly 2,300 since 1920. This decrease is no doubt due in part to the extension of suburban electrification and to falling traffic, but to some extent the decrease is apparent rather than real because, firstly, numbers

of locomotives are not an adequate quantitative expression of engine-power, since individual locomotives may become more powerful, and, secondly, improved organization has reduced the time taken by repairs and overhauls. Locomotives are now released more quickly for traffic duties and thus a smaller number of engines suffice for a given amount of traffic. The L.M.S.R., for example, on amalgamation in 1923 possessed 10,316 locomotives made up of 393 different types, but by the end of 1931 the number had been reduced to 9,032 of 261 types. Eventually it is hoped to reduce the number of types to 20, so as to obtain economies in repair work. By adopting a system of progressive repairs the time in the shops for one type of engine has been reduced from $5\frac{1}{2}$ weeks in 1925 to 12 days in 1927 and to 6 days in 1930. Greater efficiency has been obtained from the locomotives in service and mechanical defects have been reduced since the grouping by 28.5 per cent. Moreover, in 1931 the mileage between general repairs has been increased by nearly 10,000 per engine from about 50,000 to 60,000 miles, and it is hoped eventually to reach a standard of 100,000 miles between repairs.*

The decrease in the number of rail cars other than electric up to 1927 was due to the discontinuance of the older types, while the subsequent increase is explained by the adoption of the modern light steam rail car.

Petrol locomotives have never attained much popularity on British railways, and in the post-war period the number has never exceeded 10. On the Continent, petrol rail cars have been adopted much more extensively, but this is probably due partly to the higher relative cost of coal. In the future, however, considerable development may be expected in the use of Diesel-oil locomotives and rail cars. The number of electric motor-cars (used for traction in electric trains of the multiple-unit type) has increased steadily since the war, as might be expected from the development of suburban electrification. In 1931 the London Underground Railways and the Metropolitan District Railway owned 1,058, or practically half the total number of electric motor-cars in operation, while 905 were owned by the Southern Railway.

There has been a marked decrease in the number of horses used for shunting, and the number owned is now less than half what it was in 1920 (see Table XXV). This decrease is mainly due to the provision of humps and gravity sidings which have been a feature of railway operating developments in the past ten years.

Coaching Stock. Statistics relating to coaching stock divided as between steam and electric stock are given in Table XXVI.

* E. J. H. Lemon, "Rationalization on the L.M.S.R.," *Journal, Institute of Transport*, July, 1932.

TABLE XXV.
Horses used for Shunting.

1913	...	...	...	1,556
1920	...	...	...	1,259
1921	...	...	...	1,172
1922	...	...	...	1,167
1923	...	...	...	1,168
1924	...	...	...	1,058
1925	...	...	...	978
1926	...	...	...	917
1927	...	...	...	851
1928	...	...	...	810
1929	...	...	...	777
1930	...	...	...	701
1931	...	...	...	620

No figures are available concerning Pullman cars in the official statistics, as these are privately owned and are operated by arrangement with the railway companies. The number is somewhat under 200.

It will be observed that there is only a slight decrease in the seating capacity of steam stock in 1931 as compared with 1913, but there has been a much greater decrease in the number of vehicles. In 1913 the average seating capacity per coach was approximately 48, but in 1931 it had risen to about 55. This is explained by the increased size of passenger vehicles. Four-wheeled coaches have practically disappeared, and six-wheeled vehicles are giving place to eight-wheeled bogie coaches.

TABLE XXVI.
Coaching Stock. (All British Railways.)

Year.	Steam Stock.		Electric Stock.	
	Number.*	Seats.	Number.†	Seats.‡
1913	52,380	2,521,721	1,467	125,709
1920	48,971	2,446,552	1,748	163,445
1921	48,820	2,473,644	1,909	174,546
1922	48,034	2,456,443	1,971	179,984
1923	47,577	2,462,167	1,872	178,524
1924	47,532	2,484,588	2,016	190,625
1925	46,486	2,475,237	2,376	239,900
1926	46,617	2,500,218	2,548	254,379
1927	47,615	2,530,517	2,591	257,387
1928	46,920	2,519,534	2,750	282,421
1929	45,858	2,490,204	2,860	300,855
1930	45,359	2,486,756	2,889	307,677
1931	44,170	2,445,072	2,980	318,563

* In 1927 a somewhat different method of counting articulated stock was adopted and figures for that and subsequent years are not strictly comparable with the previous years.

† Excludes motor vehicles.

‡ Includes motor vehicles.

In 1931 the total seating capacity of electric stock, including motor vehicles, was 318,563 seats, and of this the four grouped railways operated 190,740 seats, the Southern Railway's share being 134,068 seats. The London Underground Railways, the Metropolitan District Railway and the Metropolitan Railway accounted between them for 113,283 seats.

During the post-war period, railway electrification has made considerable progress in suburban areas and the Southern Railway possesses the greatest electrified suburban system in the world, covering now 359 route miles, or 978 track miles. Main line electrification, however, has made no progress at all, if we exclude the recent electrification of the London to Brighton and Worthing line. But even this line partakes more of the characteristics of suburban electrification than main line electrification. It carries a dense passenger traffic largely concentrated in the form of morning and evening "rush-hour" traffic. The adoption of multiple-unit traction illustrates the essentially suburban nature of the scheme, since this method was adopted owing to the need for a rapid turn round at termini and because it avoids locomotive shunting movements which might delay incoming traffic.

Outside of the London area even suburban electrification has made practically no progress with the exception of the recent electrification of the Manchester, South Junction and Altrincham Railway in 1931, which is about 9 miles in length. This is the first passenger line to be worked on the 1,500 volt overhead conductor system as recommended in the 1927 Report of the Pringle Committee.

Main line electrification would not seem to be an economical proposition in this country because the large capital expenditure necessary would not be justified except in those few places where a dense traffic is available. In the absence of precise costs of main tenance and working it is difficult to assess the results of electrification and, unlike other traction developments, nothing but a large-scale experiment could even establish the working results, as the length of line would require to be such as to cover present steam locomotive runs so as to obtain economic use of expensive locomotives. The extra cost is very largely a fixed sum per mile, but any saving which can be obtained is a definite amount per train-mile. At the present time wholesale electrification, even apart from other considerations, would be a very speculative undertaking owing to the possible development of the oil-electric rail car and locomotive. These do not necessitate the expense of laying conductor rails or wires, but at the same time they could provide many of the advantages of electric traction. Neither do they necessitate the stereotyping of traction methods such as would be inevitable

if wholesale electrification were adopted. On the other hand, the capital cost of the oil-electric is about three times that of a steam locomotive, though its availability in traffic is also greater. On suburban services with dense traffic, however, electrification would probably show a saving over oil-electric traction. Finally, in considering methods of traction it must be remembered that finality has not yet been reached in steam engine design and further improvements are still possible in the steam locomotive.

Merchandise and Mineral Wagons. Statistics relating to merchandise and mineral wagons are necessarily incomplete, since the official figures refer only to railway-owned wagons. In addition to these there are some 600,000 privately-owned wagons, which is a number not far short of that owned by the railways themselves. No exact figures are available, but a census taken on 31st January, 1923, showed the number of private-owners' wagons to be 638,215, of which approximately 90 per cent. were used principally for coal and coke traffic. In Table XXVII the number, tonnage capacity and average capacity of railway-owned wagons are given.

TABLE XXVII.

Railway-owned Merchandise and Mineral Wagons. (All Railways.)

Year.	Number including Brake Vans	Tonnage Capacity excluding Brake Vans	Average Capacity per Wagon excluding Brake Vans.
1913	735,294	*	*
1920	724,380 †	*	*
1921	740,162	7,435,460	10.236
1922	722,639	7,324,418	10.330
1923	714,246	7,311,801	10.438
1924	718,613	7,457,902	10.580
1925	721,359	7,602,942	10.749
1926	720,860	7,665,856	10.844
1927	717,741	7,717,526	10.965
1928	706,081	7,674,258	11.083
1929	700,093	7,690,405	11.201
1930	690,216	7,644,537	11.301
1931	682,750	7,594,513	11.351

* Not available.

† Includes wagons not returned from overseas.

It will be observed that there has been a fairly considerable reduction in the number of vehicles since 1921, amounting to about 8 per cent., but the tonnage capacity has increased owing to an increase in average capacity. In 1921 the average capacity was 10.236 tons, but in 1931 it had risen to 11.351 tons, due to the adoption of 12-ton wagons as the standard for all new open and covered ordinary wagons.

Larger wagons of 20 tons or more in capacity are the exception rather than the rule in this country. There has, however, been a small increase in the number of such wagons in the post-war period. In 1926 there were 24,801 large-capacity wagons, of which 23,591 were utilised for mineral traffic. By 1931 the number had increased to 28,915, of which 26,867 were mineral wagons.

High-capacity wagons have undoubted advantages for mineral traffic, and their more general adoption would reduce the cost of handling traffic considerably besides increasing the efficiency of railways in other ways. But the main difficulties in the way of their adoption lie in the cost of re-equipping collieries and ports to take the larger wagons, together with the disinclination of traders to use larger wagons. In the retail coal trade indeed the organization is such that even the 12-ton wagon is sometimes too large!

For general merchandise, which passes in relatively small quantities and requires a rapid service, there is practically no demand for wagons of a greater capacity than the standard 12-ton wagon. Actually truck loads of merchandise in 1931 worked out at the low average of 2.83 tons as compared with 9.40 tons for coal and coke. Partly this is due to the difference between axle loads and cubic capacity, and partly it is accounted for by the fact that wagons are not held up waiting for full loads but are dispatched to avoid delay if a direct load of as little as one ton is available.

TABLE XXVIII.
Ancillary Enterprises, 1931.

	S.R.	G.W.R.	L.M.S.R.	L.N.E.R.	Total (all Railways).
Steamboats, No. ...	47	16	57 *	44 *	160
Steamboats, net registered tonnage ...	21,936	7,111	26,623	23,706	78,027
Canals, No. ...	2 †	10 †	13 †	12	35
Canals, length ...	3 m. 19 ch.	211 m. 4 ch.	537 m. 22 ch.	285 m. 15 ch.	1,036 m. 60 ch.
Docks, Harbours and Wharves, length of quay in feet ...	41,988	164,764	95,574	204,050	513,895
Hotels, No. ...	9	7	34 †	31 †	81
Land, acres ...	5,194	4,949	11,772	13,769	32,407
Houses, No. ...	8,390	3,863	25,348	18,097	58,768

* Including five jointly owned and one jointly worked.

† Including one jointly owned.

As regards private-owners' wagons, as has been said, 90 per cent. are utilised for the conveyance of coal and coke. The balance of

10 per cent. represents for the most part special types of wagon such as oil tankers, ore hopper wagons, or yeast vans. Coal and coke wagons belong to over 5,000 owners, though about one-third are the property of wagon-hiring firms.

Ancillary Services. British railways, in addition to their purely railway service, carry out many kinds of enterprises which are incidental to, or connected with, their rail services. They are important owners of docks, wharves, hotels, steamships, lands, houses and canals. A summary statement of these ancillary businesses will be found in Table XXVIII.

Railway Labour. In Table XXIX the number of persons employed on British railways is given. Between 1921 and 1931 there was a reduction in staff of 16·3 per cent. This has been due to a combination of circumstances, including redundancies brought about by amalgamation, loss of traffic and increased mechanization stimulated by high wage rates.

TABLE XXIX.

Railway Staff. (All Railways, including Railway Clearing House, but excluding Manchester Ship Canal.)

1921	...	...	...	...	735,870
1922	...	...	...	...	676,802
1923	...	...	...	...	681,778
1924	...	...	...	...	700,573
1925	...	...	...	...	702,062
1926	...	...	...	...	689,264
1927	...	...	...	...	683,077
1928	...	...	...	...	677,148
1929	...	...	...	...	642,137
1930	...	...	...	...	656,530
1931	...	...	...	...	615,592

Operating Statistics. Under the Railways Act, 1921, the railway companies were required to furnish the Ministry of Transport with more detailed statistical information regarding their work than was previously required. The changes introduced and the nature of the new statistics were ably described in a paper read before this Society on March 17th, 1925, by Mr. (now Sir) C. W. Hurcomb,* and there is, therefore, no need for me to explain the nature of these changes. Suffice it to say that the new statistical information was intended to determine how far that "efficient and economical working and management" of the railways was being attained which was to be the basis on which the railways were to be allowed to earn the "Standard Revenue."

In this way, statistical information became available for the

* *Journ. Roy. Stat. Soc.*, Vol. LXXXVIII, Part III, May, 1925.

first time regarding ton-miles, engine-mileage, engine-hours, train- and wagon-miles and other operating details.

As early as 1850 Dionysius Lardner had recommended the calculation of such information and had suggested that a statistical bureau should be set up by each railway administration for organizing and recording statistical data. In 1902 the former N.E.R. commenced to compile ton-miles, wagon-miles, passenger-miles and other special statistics for their own administrative purposes, but detailed operating statistics were not available from all railways until 1923.

Tonnage alone is not in itself an adequate measure of work done, since it ignores the vital factor of distance. Ton-miles, however, reflect both distance and weight carried, but it will be realized that ton-miles must be considered in relation to operating efficiency with regard to traffic density in relation to distances. For example, compact heavy tonnages over short distances are vastly different from light tonnages over long distances, although the deduced ton-miles might be similar. In Great Britain ton-miles are calculated on the weight of the contents of the wagons and are, therefore, net figures. In Table XXX the total net ton-miles worked are shown for the years 1923 to 1931, and it will be observed that the ton-miles worked in 1931 were only 16,322 million as compared with 18,855 million in 1929 and 18,961 million in 1923.

TABLE XXX.

Total Net Ton-miles worked. (All Companies. Standard Gauge.†)*
(000,000's omitted.)

Year.	Merchandise and Live-stock‡ (excluding Classes 1 to 6).	Minerals and Merchandise ‡ (Classes 1 to 6).	Coal, Coke and Patent Fuel.	Total.
1923	5,264.7	3,497.6	10,198.3	18,960.6
1924	5,534.9	3,624.6	9,903.0	19,062.6
1925	5,542.4	3,473.8	9,315.9	18,332.2
1926	5,148.9	2,788.6	6,104.2	14,041.8
1927	5,693.9	3,682.7	9,470.8	18,847.3
1928	5,538.7	3,532.0	8,662.5	17,733.1
1929	5,653.5	3,790.7	9,410.8	18,855.0
1930	5,365.6	3,545.1	8,882.5	17,793.2
1931	4,941.9	3,046.1	8,334.3	16,322.4

* Includes free-hauled traffic.

† Excludes Manchester Ship Canal.

‡ Before 1926 the basis of classification was "Merchandise and Live-stock," "Other Minerals," and "Coal, Coke and Patent Fuel."

If ton-miles are divided by the railway route mileage an average figure can be obtained of the traffic density. From Table XXXI it

will be seen that the average amount of freight traffic per route-mile amounted to 808,598 tons in 1931.

TABLE XXXI.

Traffic Density. Average net Ton-miles per Route-mile per annum.

1923	...	...	...	943,549 tons
1924	...	...	...	947,540 "
1925	...	...	...	909,785 "
1926	...	...	...	695,205 "
1927	...	...	...	933,267 "
1928	...	...	...	878,659 "
1929	...	...	...	934,294 "
1930	...	...	...	881,770 "
1931	...	...	...	808,598 "

The average length of haul can be obtained by dividing the ton-miles worked by the tonnage. In the published official returns it will be found that the average lengths of haul from merchandise, coal and mineral traffic are greater than the figures shown for any individual company, but the former relate to throughout journeys, while the latter refer only to the average length of haul on the individual systems. In Table XXXII the average length of haul is shown for all railways in Britain.

TABLE XXXII.

Average length of Haul in Miles. (All Railways. Standard Gauge. Excluding free-hauled.)*

Year.	Merchandise (except Classes 1 to 6) and Live-stock.	Minerals and Merchandise (Classes 1 to 6).	Coal, Coke and Patent Fuel.	All Freight.
1923	84.13 miles	54.22 miles	42.43 miles	51.95 miles
1924	85.55 "	53.53 "	43.40 "	53.26 "
1925	87.17 "	53.57 "	44.03 "	54.33 "
1926	90.70 "	56.26 "	47.81 "	60.64 "
1927	89.15 "	54.15 "	43.70 "	54.60 "
1928	91.07 "	55.19 "	41.81 "	53.99 "
1929	92.78 "	56.25 "	41.76 "	53.79 "
1930	94.83 "	58.66 "	42.13 "	54.77 "
1931	97.77 "	61.11 "	44.02 "	56.83 "

* Excluding Manchester Ship Canal.

It will be noticed that the average length of haul has tended to increase, especially in the case of general merchandise. This is due, no doubt, in part at any rate to road competition, which has been keenest in the case of short-haul traffic. The increase in the average length of haul for coal in 1926 was, of course, due to the special conditions brought about by the General Strike and the coal dispute. In many other countries the average length of haul is considerably

longer than in Britain, *e.g.* Austria 90 miles, Germany 104 miles and the U.S.A. 318 miles.

Ton-miles divided by loaded-wagon miles give the average wagon load in tons. These are shown in Table XXXIII below.

TABLE XXXIII.
Average Wagon Load in Tons.

Year.	Merchandise (except Classes 1 to 6) and Live-stock.	Minerals and Merchandise (Classes 1 to 6).	Coal, Coke and Patent Fuel.	All Freight.
1922	2.86 tons	8.45 tons	9.04 tons	5.52 tons
1923	2.88	8.50	9.12	5.65
1924	2.93	8.59	9.11	5.61
1925	2.90	8.61	9.16	5.50
1926	2.89	8.50	9.17	5.06
1927	2.90	8.79	9.26	5.60
1928	2.94	9.01	9.36	5.54
1929	2.94	9.07	9.43	5.65
1930	2.89	9.14	9.44	5.59
1931	2.83	9.15	9.40	5.50

In this and the previous table it should be noted that a slight change in the basis of classification had been made in 1926.

It would seem from the figures that periods of general trade depression tend to reduce the average wagon load in the case of general merchandise. There is less traffic flowing, but traders expect to receive the same service. It will also be noticed that average wagon loads for coal, coke and other mineral traffic have steadily increased during the post-war period. This has been due to the increase in the average wagon capacity.

TABLE XXXIV.
Average Freight Train Load in Tons.

1920	...	...	...	...	132.49 tons
1921	...	...	...	...	121.17 "
1922	...	...	...	...	127.54 "
1923	...	...	...	...	132.57 "
1924	...	...	...	...	132.64 "
1925	...	...	...	...	130.02 "
1926	...	...	...	...	124.47 "
1927	...	...	...	...	130.87 "
1928	...	...	...	...	127.09 "
1929	...	...	...	...	130.92 "
1930	...	...	...	...	127.71 "
1931	...	...	...	...	124.73 "

The average freight train load in tons is obtained by dividing the net ton-miles worked by the total train-miles, while the average number of wagons per train is obtained by dividing the number of wagon-miles by the number of train-miles. Tables XXXIV and

XXXV give the figures for train loads and the number of wagons per train respectively.

The average load of freight trains in Great Britain is very low as compared with that in many other countries, notably the United States, where a figure of something like 600 tons is obtained. Conditions, however, are very different in Britain, which is a country of short hauls and one in which traders expect and obtain a better service than is given in other countries. The modern tendency in Britain is if anything to run shorter trains but to increase their speed. A large number of express-braked goods trains are now operated, and these are generally limited to a load of 30 to 40 wagons. In 1932, for example, the number of such trains on the L.M.S.R. was nearly double that in 1931. They can be operated economically with comparatively moderate loads when their speed is high. In this case statistics relating to wagon-miles per train-engine-hour give a better index to efficiency than average loads.

TABLE XXXV.
Number of Wagons per Train.

Year.	Loaded.	Empty.	Total.
1920	24.49	10.27	34.76
1921	23.90	10.59	34.49
1922	23.12	11.44	34.56
1923	23.46	11.65	35.11
1924	23.66	11.53	35.19
1925	23.62	11.43	35.05
1926	24.62	10.48	35.10
1927	23.36	11.26	34.62
1928	22.93	11.10	34.03
1929	23.19	11.30	34.49
1930	22.84	11.30	34.14
1931	22.67	11.45	34.12

From Table XXXV it will be observed that approximately one-third of the wagons in the average goods train consist of empties. The haulage of empty wagons cannot be completely eliminated owing to the unbalanced nature of railway traffic on many routes. Coal wagons especially have frequently to be returned empty to collieries, while private-owners' wagons must be returned by a direct route, thus involving the railways in much empty haulage. As regards their own wagons, the companies have done much to reduce the proportion of empty mileage by means of wagon control schemes. During the war a system of common-user was adopted, and this has been retained for certain types of wagon most commonly used. Attempts have also been made to set up wagon-pooling schemes in

connection with the privately-owned wagons belonging to collieries, but so far progress has been slow. The G.W.R. have unsuccessfully sought powers for dealing with the privately-owned wagon and have this year introduced a hiring scheme. They are constructing 5,000 wagons of 20 tons capacity which will be let out on redemption hire terms to approved colliery companies, and it is expected that they will enable the whole of the export coal in South Wales to be shipped from high-capacity wagons.

The next two tables (Tables XXXVI and XXXVII) refer to engine-mileage, distinguished between Train, Shunting and Other Miles in the first table and according to the mode of traction in the second.

TABLE XXXVI.

Engine-mileage. (Companies' Engines. All Companies.)*

(000,000's omitted.)

Year.	Train Miles.			Shunting Miles			Other Miles.	Grand Total.
	Coaching.	Freight.	Total.	Coaching.	Freight.	Total.		
1913	260.7	155.4	416.0	17.8	114.3	132.1	53.0	601.2
1920	219.0	144.7	363.8	16.9	116.4	133.4	58.5	555.6
1921	205.4	109.7	315.1	15.7	87.0	102.7	48.4	466.2
1922	239.4	131.9	371.3	16.6	99.7	116.3	53.4	541.1
1923	251.7	143.1	394.8	17.0	109.6	126.6	58.3	579.7
1924	254.6	143.8	398.4	17.3	111.2	128.4	60.8	587.7
1925	261.8	141.1	402.8	17.5	109.3	126.9	60.2	589.9
1926	233.6	112.9	346.5	15.7	89.3	105.0	50.2	501.7
1927	268.9	114.1	413.0	17.3	112.8	130.0	59.9	602.9
1928	277.2	139.5	416.7	17.5	106.8	124.3	57.9	598.8
1929	283.3	144.1	427.4	17.5	109.7	127.2	58.6	613.1
1930	284.8	139.4	424.2	17.4	104.5	121.9	55.3	601.4
1931	280.7	131.0	411.7	17.1	97.3	114.4	51.6	577.6

* Excludes Manchester Ship Canal.

Coaching train miles, apart from the exceptional year 1926, have increased steadily from 1921 to 1930, thus indicating that the railways have increased the number of their passenger service facilities. Freight train miles, on the other hand, have shown no such increase. The use of high-powered locomotives and the decreased traffics have resulted in decreased double heading by 29 per cent. in the case of passenger and 50 per cent. in the case of freight, so that certain mileage of the assisting engine formerly treated as auxiliary mileage has disappeared and the relation of train to engine miles has increased.

The mileage operated by electric traction has nearly doubled since 1921, while another noticeable feature has been the increase in the mileage worked by rail cars since 1927.

TABLE XXXVII.

*Engine-mileage according to mode of Traction. (Companies' engines.
All Companies.*)*
(000,000's omitted.)

Year.	Steam Locos.	Electric Traction.	Steam and other Rail Cars.
1913	569.9	27.2	4.1
1920	521.6	33.0	1.0
1921	433.7	31.5	1.1
1922	507.2	32.6	1.5
1923	545.0	33.0	1.7
1924	552.1	33.9	1.7
1925	549.5	38.8	1.6
1926	459.7	40.7	1.3
1927	553.5	47.8	1.6
1928	545.6	50.7	2.6
1929	555.4	54.0	3.7
1930	541.4	56.1	3.8
1931	516.4	57.6	3.6

* Excludes Manchester Ship Canal.

The Engine-hour as a Unit of Cost. Although the engine-hour varies widely in regard to quality of power and performance, such as the use of a Garratt engine compared with a small tank locomotive, it is free from the disturbing influence of changes in rates of wages and in price of materials, and in combination with other units such as train-miles or net ton-miles it provides useful indices of the efficiency of traffic operation. Table XXXVIII sets out the statistics relating to train-miles per train-hour and train-miles per engine-hour. The most noticeable feature of this table is the steady trend in improved operating efficiency during the post-war period. In 1920 passenger trains while in service moved an average distance of 12.99 miles each hour, including signal checks, platform duties and turn-round delays, but by 1931 the distance had been increased to 14.72 miles. These statistics are, of course, affected by the withdrawal of local trains due to the closing of branch lines, which increases the percentage of faster trains, and they include a measure of any improved rostering of train engines, because a mere increase in train speed with a corresponding increase in the time the train spent waiting for its next journey would not be shown in the figures. Engine working as distinct from train working is measured by the train-miles per engine-hour, and this includes time spent in shunting, assisting and light running. It will be seen from the table that for every hour in which passenger locomotives were in traffic they moved on the average 10.10 miles in 1920, but by 1931 the distance was increased to 11.66 miles.

For freight trains the average hourly mileage was 7·74 miles in 1920 as compared with 9·11 miles in 1931. In the same period the mileage per engine-hour increased from 3·18 to 3·61 miles. The tables also illustrate the small proportion of useful work in traffic which can be obtained from locomotives.

TABLE XXXVIII.
Train and Engine Hours.

Year.	Train-miles per Train-hour.		Train-miles per Engine-hour.	
	Coaching.	Freight.	Coaching.	Freight.
1920	12·99	7·74	10·10	3·18
1921	13·24	8·81	10·22	3·41
1922	13·85	8·85	10·72	3·51
1923	13·87	8·49	10·79	3·42
1924	13·80	8·20	10·74	3·34
1925	13·90	8·23	10·82	3·34
1926	13·81	7·97	10·80	3·26
1927	14·14	7·98	11·08	3·27
1928	14·33	8·66	11·28	3·44
1929	14·47	8·43	11·42	3·41
1930	14·59	8·83	11·55	3·53
1931	14·72	9·11	11·66	3·61

A considerable saving in costs would be obtained if it were possible to increase the train-mileage per engine-hour, and to this end many operating improvements have been introduced during recent years, such as train control and improved signalling. There are, however, many difficulties to be surmounted, since traffic considerations, particularly the time and place of traffic demands, differences in the speed of different trains, station duties and the like have all to be taken into account.

In Table XXXIX the average net ton-miles per engine-hour are shown per train-engine-hour, per shunting-hour and per total engine-hour. These are important figures from the operating efficiency point of view, as they take account of train and wagon loading, speed of movement and productive and unproductive time spent by engines. It is necessary, of course, to take into account the density and distance, representing the compactness of the traffic.

Wagon-miles per engine-hour are shown in Table XL. These statistics when compiled for different areas and localities are very useful to the companies as a check on operating efficiency.

Passenger-miles are only calculated for two months of the year, namely, February and September, and for reasons of economy the figures are partially estimated. Table XLI shows the number of

passenger-miles operated and the average distance per passenger journey, during the month of September, for the years 1927–30. They were not compiled for any period in 1931.

TABLE XXXIX.

Average net Ton-miles per Engine-hour. (All Railways.† Standard Gauge.)*

Year.	Per Train-engine-hour.‡	Per Shunting-hour.	Per total Engine-hour.
1923	951.23	865.41	453.15
1924	916.65	857.96	443.17
1925	901.13	838.98	434.47
1926	836.94	786.80	405.55
1927	877.71	836.36	428.27
1928	925.09	832.45	438.16
1929	929.41	860.16	446.72
1930	956.89	852.14	450.74
1931	968.29	839.70	449.71

* Includes free-hauled traffic.

† Excludes Manchester Ship Canal.

‡ Including Assisting and Light.

TABLE XL.

Wagon-miles per Engine-hour.

Year.	Train.*	Shunting.	Total.
1923	251.90	229.10	119.98
1924	243.22	227.61	117.58
1925	242.93	226.12	117.11
1926	235.92	221.76	114.31
1927	232.18	221.24	113.29
1928	247.63	222.87	117.30
1929	244.87	226.62	117.70
1930	255.79	227.79	120.49
1931	264.88	229.71	123.02

* Including Assisting and Light.

TABLE XLI.

Passenger-miles. (Month of September.)

(000,000's omitted.)

Year.	Passenger-miles.	Average Distance per Passenger Journey.
1927	1,876.4	13.40 miles
1928	1,930.2	13.87 "
1929	1,973.1	13.83 "
1930	1,835.2	13.20 "

In the final table (Table XLII) the work performed by all the railways of Great Britain is summarised. It will be seen that even in the depth of the trade depression of 1931, the railways carried more than 173 million tons of coal, coke and patent fuel, over 94 million tons of goods and minerals, over 875 million ordinary passengers, 280 million workmen, over 749,000 annual season ticket-holders, equivalent to something like another 450 million passenger journeys, and nearly 14 million head of live-stock.

The railways still remain the backbone of inland transport facilities in Great Britain, despite the progress which has been made by mechanical road transport since the war. They are especially well suited for the carriage of heavy traffic, raw materials, bulky articles or low-grade commodities at the one end of the scale and for the rapid transit of small lots over long distances at the other. The coal trade and most of the other "heavy" industries are essentially dependent on the railways, since their products could not be conveyed by road over long distances or in large quantities. Railways can also cater more effectively for intensive passenger services and for long-distance travel, both passenger and goods. The high speed which is possible on the special and carefully safeguarded permanent way of the railways gives them a great advantage over road transport on the long haul.

TABLE XLII.

The Work of the Railways of Great Britain. (All Companies.)

Year.	Coal, Coke and Patent Fuel.* Tons, 000,000's.	Other Minerals and Goods Traffic. Tons, 000,000's.	Passengers.			Live-stock. Number, 000,000's.
			Ordinary. Number, 000,000's.	Workmen. Number, 000,000's.	Season Tickets.† Journeys, 000,000's.	
1913	225.6	138.8	943.6	255.7	350.5	19.5
1920	181.2	136.8	1,119.9	459.1	606.7	17.1
1921	128.3	89.6	922.6	306.8	557.2	16.8
1922	200.1	101.5	895.1	299.6	554.3	16.7
1923	222.2	121.0	925.3	310.3	536.2	17.3
1924	209.2	125.3	925.9	310.3	510.7	17.8
1925	193.7	122.3	924.0	308.6	510.7	18.7
1926	114.1	101.5	808.8	260.2	472.9	18.2
1927	195.8	126.1	887.8	287.0	476.3	19.7
1928	187.3	118.8	893.7	302.2	470.5	19.1
1929	207.1	122.4	926.8	309.4	468.5	17.7
1930	193.3	111.1	916.7	300.6	467.4	16.1
1931	173.7	94.7	875.9	280.5	449.8	13.7

* Excludes free-hauled.

† Equivalent number of annual season tickets, estimated at 600 journeys per annum.

DISCUSSION ON DR. FENELON'S PAPER

SIR JOSIAH STAMP: In rising to propose a vote of thanks to Dr. Fenelon I do so without reservation of any kind, having nothing but praise for the industry with which he has brought his material together, the clearness with which he has set it out, and the moderation and care with which he has made his comments upon it. The whole subject of railways in every country of the world is so prominent that it must be very useful to have in our *Journal* so valuable a compendium of all the figures that really matter in a situation that is changing so rapidly, because to obtain this amount of information would require considerable industry and research in a number of different quarters. Dr. Fenelon has brought together in the most useful and handy form those figures which are essential if we are to understand what is happening in a rapidly changing world.

I would not like anyone to think my vote of thanks lukewarm because it will be brief. I am anxious that I shall not be mistaken, because if I were to speak at any length I should be duplicating my many opportunities for speaking on this subject, and crowding out the comments of others who have fewer. I might also be regarded as abusing my position. It is not the custom in this Society to expose oneself to the charge of abusing one's position. I should feel terribly hurt if anybody as a result of my remarks should take a railway journey to-morrow that they would otherwise not have thought of doing. In my twenty-five years association with this Society, I have never known any Fellow endeavour in any way to forward his own outside interests! Dr. Snow believes that there is nothing like leather, but, for all we know in this hall, he might be a perfectly innocent civil servant; nor have I ever known Mr. Macrosty attempt to describe the beauty of character in the Civil Service. So let no one think because I do not go into detail in discussing this paper, that I have not a very high opinion of it.

Dr. Fenelon has rendered a great service in putting this material together. There are, however, one or two observations I would like to make, which will not transgress against the severe rules I have laid down for myself. Dr. Fenelon has referred to the history of Government ownership and the fact that it had some considerable influence. Much more might be written on this matter, because the effect of Government ownership was, I think, not merely that the railways fell behind in their equipment, but on the whole attitude to labour, costs, the loss of time in realizing the position with regard to the roads, and the necessity after coming out of Government ownership for amalgamation, bringing about a revival of that curious attitude on the subject of regulations, really appropriate to the 'fifties and 'sixties rather than to the twentieth century, which is only just showing faint signs of disappearing. The regulations of the railways on the subject of safety everyone understands, but the kind of things imposed upon the railways, even down to their road powers in 1928, belongs to an order of ideas of thirty or forty years previously. Government ownership considerably delayed recog-

dition of the facts in these directions and also the possibility of organizing changes to meet altered economic conditions.

You should not view the whole of the figures of this paper as "changing railways" *against* a static world; they are changing railways at the same time as, and in consequence of, a changing world. The whole question of the proportions of foreign trade is shifting. The relations between high prices and capital stocks are profound economic changes, no less than the visible ones brought about by the rise of the internal combustion engine.

Dr. Fenelon says (p. 386) that "on the whole it would seem that traffic pooling should be to the advantage of railway users *provided reasonable safeguards* for the benefit of the public and traders were introduced." Even there you see that so progressive a mind as his seems to allow this cloven hoof of "control" to come in. If the railways are spreading they must be carefully watched and regulated, whereas anyone else doing the same kind of work need not be! We shall find a vestigial appendix of it for many years to come, and nothing but a major operation will secure its removal. He refers to the problems thrown up by the large scale organizations. Here again it is not merely a question of the *size* of a railway. The railway with which I am connected is the biggest business in the Empire and second-biggest business in the world, according to capital, number of employees, and other tests. That in itself creates certain problems, and those problems require changes. In local conditions, in staple industries, such as cotton, matters are changing, and there is considerable unemployment. They, too, reflect on the necessity for different organization; departmental organization suitable for one branch is not suitable for another.

There is also the function of time. The moment you bring together a number of units that have been built as separate unities, a process of time change is set up. There must be a demand for high centralization, followed later by decentralization of different kinds.

Dr. Fenelon touched very lightly upon the undermining of the old system of differential charges now coming on, which may be of profound interest to all the industries built up upon a system of classification which has lasted for a hundred years. These are not problems peculiar to this country. Railway expenditure is relatively inelastic, but there is an important discontinuity in the way in which it contracts with contracting receipts. Scale is highly important; a small-scale reduction in receipts is not easily met. The train may be slightly shortened, but it must still run. If there is a large reduction in receipts, by taking off whole trains you may effect a larger reduction in expenditure. Reduction in railway expenditure is not a continuous factor; it moves in jerks or in steps.

This problem of the number of consignments is interesting. Dr. Fenelon rightly points out that as an effect of the war conditions the retailer became first of all increasingly nervous of taking the risk of changing prices of stocks. These rapid changes of price forced him to keep smaller stocks. Then came the vast increase in the number of types of commodities of the same class of goods. The retailer boasts that he will supply shirts in ten different lengths and

fourteen different colours. That is all very nice, but may be very expensive; still, the practice is with us and it has this effect, that the retailer is throwing his capital risks upon two things, the transport system and the telephone, and also upon two classes, the wholesaler and distributor. This has proceeded to such an extent that it has made considerable changes in the centre of gravity of financial depression and boom, and is not unimportant in the development of the economic problem of booms and depressions.

I have much pleasure in proposing this vote of thanks, with very great sincerity, to Dr. Fenelon.

DR. E. C. RHODES: I have much pleasure in supporting Sir Josiah Stamp in this vote of thanks. As time is progressing rather quickly I would like to confine the remarks I have to make to one particular part of Dr. Fenelon's paper, the part which relates to operating statistics. These are of great interest to statisticians, and provide very good illustrations of the use to which averages can be put in order to convey to persons concerned the way in which a particular business is working.

We imagine the various departmental Managers of Railway Companies sitting in their offices each morning, and receiving reports relating to averages of this kind, and in that way keeping under their control the particular aspect of the business with which they are concerned. If a particular average misbehaves itself in any way, they immediately ask for an explanation. I often wonder when I look at some of the railway operating statistics whether the figures which are calculated are actually performing their job. I would like to illustrate my meaning by certain figures relating to the average wagon-loads.

The average wagon-load is obtained, as Dr. Fenelon says on p. 413, by dividing the net ton-miles worked by the total wagon-miles. This is a particular figure supposed to indicate how far the railways are moving their traffic as economically and speedily as possible in as few wagons as possible by securing the maximum wagon loads. The following few figures are certain average wagon-loads:—

Southern Railway.

Year.				Average Wagon-load all freight (tons).
1928	...	...	...	4.85
1929	...	...	...	4.91

All freight is usually sub-divided into three main classes: (1) merchandise and live stock, (2) merchandise and minerals, (3) coal, coke and patent fuel.

The following table shows the average wagon-loads of these classes.

		(1).	(2).	(3).
1928	... ..	2.77	8.52	9.13
1929	... ..	2.72	8.42	9.11

Anyone looking at the "all freight" figure would infer a rise in the average wagon-load, whereas actually, as the detailed figures show, there has been a decline. What is happening is that between the two years there is a redistribution between the three classes of freight. The two heavier classes were conveyed in greater proportion to the total freight in the second year and they increased the average. The change in average is mostly a reflection of a change in redistribution of freight. It is not a reflection of a change in loading, but the statistician assumes that the average wagon-load is a means of finding out whether there has been such a change and this method of detecting it has broken down in this case.

When this is considered in more detail, taking all freight for all railways over the whole country, we have to realise that all freight is divided into these three classes and the whole country sub-divided into four great railway groups, and each railway group, except the Southern, is divided into different areas. In each of these different areas there are different averages for wagon-loads owing to the peculiar distribution of industry in the country, and any change in time in a distribution of industrial activity would be reflected in the average wagon-load, so that for any given year an average wagon-load may show an increase not due to actual change in loading, but due to the fact that there was a bigger proportion of the trade in that year in a district where the average load was high because (say) a great deal of coal was conveyed in that particular area.

The changing distribution of freight carried can be seen in the table below :—

All Freight (Million Ton Miles).

				Percentages.	
				1928.	1931.
Southern	...	...	...	4.2	4.9
G.W.(W.)	...	...	...	5.4	6.0
(M.)	...	...	...	5.0	5.1
(S.W.)	...	...	...	7.9	7.1
L.M.S.(W.)	...	...	...	14.1	13.7
(C.)	...	...	...	4.3	4.0
(M.)	...	...	...	17.0	17.3
(N.S.)	...	...	...	4.7	4.1
(N.N.)	...	...	...	1.2	1.2
L.N.E.(S.E.)	...	...	...	4.6	5.1
(S.W.)	...	...	...	15.0	15.9
(N.E.)	...	...	...	9.5	8.9
(S.S.)	...	...	...	4.4	4.2
(N.S.)	...	...	...	0.2	0.2
Total	...	...	...	100	100

The proportions in different areas are different and therefore the average wagon-loads will be different in the two years merely because activity in industry has been somewhat redistributed as between those two years.

I would like to plead for some sort of standardized average instead of the ordinary crude average wagon-load. All the Fellows of the Statistical Society are acquainted with standardized death rates, where exactly the same kind of problem is involved. The incidence of death is different for age and sex. In order to get a proper appreciation of the changes taking place in time, a standardized death rate is calculated taking into account changes that have occurred in the age and sex distribution of the population. The same kind of thing could be done here. We could easily work out a standard average wagon-load, getting rid of changes in distribution of trading activity as between different areas and freight carried.

I should think that probably many others of these operating statistics could be submitted to the same sort of standardizing process.

In conclusion, I would like to second the vote of thanks proposed by Sir Josiah Stamp. I think Dr. Fenelon's paper will prove to be a very useful survey to many of us, when we want to present facts relating to the Railways; instead of having to look them up in the annual or monthly railway reports, we shall find them in this paper.

The vote of thanks proposed by Sir Josiah Stamp and seconded by Dr. E. C. Rhodes, was put to the meeting and carried unanimously.

MR. A. E. KIRKUS said that Dr. Fenelon in his able and comprehensive review had referred to a paper read before the Society on Official Railway Statistics by Sir Cyril Hurcomb eight years ago, and it was interesting to recall that Sir Cyril, in his concluding remarks on that occasion, said "the Railway Companies themselves, the travelling public, the traders and the economists can refer to these statistics as a quarry or an arsenal from which to draw the material or the weapons for their respective purposes." Dr. Fenelon had evidently regarded them as a quarry, and it could be said that he had made full use of its resources. There was, however, one stone left unturned—namely, the statistics relating to railway accidents, and these were worthy of some notice.

In the years 1929, 1930 and 1931, the last years for which the figures had been published, the average number of persons killed per annum on trains or by the movement of railway vehicles, was 325, or less than one per day. If trespassers and suicides were included, the average was nearly two per day. The number of persons killed on the roads was unfortunately as high as an average of 19 per day. Of the total of 325 killed on railways, only four passengers in trains involved in collisions were killed. This small number provided a striking tribute to the working arrangements and the management of the companies, and it illustrated the truth of the saying that the safest place in the world was a railway train.

Dr. Fenelon had referred to the low dividends received by the holders of ordinary stock, and the large amount of capital which now received no remuneration at all. Unfortunate as the financial position of the railways was, it would undoubtedly have been much worse but for the amalgamations which were effected as the result of the passing of the Railways Act of 1921. By the merging of some 120 undertakings into four groups, very large economies had been effected in standardization of rolling stock, overhead expenses, and in other directions. Economies had resulted also from more efficient control, in which connexion Dr. Fenelon had mentioned the improvement which had occurred in the number of train-miles run per engine-hour. It was interesting to note that if the number of train-miles per hour in 1931 had remained the same as in 1922, the year prior to the amalgamations, the number of engine-hours worked by steam engines alone would have been increased by something like two million. Notwithstanding all the economies which had been made, there was no evidence that the travelling public or the traders were receiving a worse service than previously; on the other hand, it was probably true to say that never in the history of the railways were the companies better equipped to deal with a substantial increase in passengers and goods when the much hoped for recovery in trade occurred.

With regard to the remarks of Dr. Rhodes as to the use of statistics, it was not probable that any General Manager would look at one figure in isolation. To do so would be dangerous. He would no doubt review the statistics as a whole and not come to a conclusion on any single figure.

COL. C. WALEY COHEN thought all were much indebted to the reader of the paper; there were one or two points, however, where he wished Dr. Fenelon had gone a little further. Sir Josiah Stamp had rightly pointed out that the railways were changing in face of the very rapidly changing local conditions of the areas they serve. It was very striking that with the enormous movement of population and industry, the railways in the South of England did not seem to have got their share of the increase either in trade or in population. The real fact of the matter was that the railways were a trading concern, and they could only succeed if they watched, as other traders did, the development in their area and, in competition with road transport, seek to assist the traders in their area.

Mr. Kirkus, of the Ministry of Transport, had said that he considered the facilities afforded by the railways were as good as they were before the war. That was a rather alarming statement, because he thought it was usually accepted that the railways had cut off many of the facilities they gave before the war. Before 1914 goods could be sent "carriage forward," payment being made by the receiver of the goods. That was now impossible, and in itself was one of the great causes of the transfer of traffic from the railways to the roads.

Colonel Waley Cohen said that recently he made a survey of the South of England to discover whether the average parcel rate of

motor vehicles was less than or equal to that of the railways for the same distance, *e.g.* from the South Coast to London and Birmingham. He was amazed to find that owing to better organization the motor car organization carried goods in larger bulk than the railways. They managed by a system of superior collection always to get a larger bulk for the same area than did the railways.

The second thing he discovered was that the enormous transfer of goods from the railways to the roads was mainly due to convenience rather than to cost of transport, and he included in "convenience" losses on the railway, and the possibility of being able to make an immediate settlement when a loss did occur.

The real curse of the railways in this country was the fact that the prior securities of railways had been made trustee securities, and the effect had been to make the railways think that they had only to increase the charges to the public to get revenue. This was illustrated in the Act of 1921, where it actually appeared in print that they could raise the charges to get the standard revenue. Even the Chancellor of the Exchequer had realised that there was a limit to what could be got out of taxpayers, just as there was to what traders could pay for freight, and anyone alive to trading conditions would have realized long before 1928 that the prodigious labour of classification undertaken by the railways was certain to be wasted because the classification, as it came out, was impossible for traders as a trading concern. The moral was that when the 1921 Act was passed there ought to have been simultaneously some kind of consideration of what sort of management would be necessary when these new huge amalgamations took place. At the same time, the moment it became certain that there was going to be an alternative transport, all the restrictions necessary for a monopoly ought to have been removed from railways. It was a retrograde step, instead of removing these restrictions from the railways, to impose them upon road traffic. The result was sure to come back on the trader; it was a pity that instead of being an advocate before the Salter Commission, Sir Josiah Stamp had not been President.

The real truth was that if the railway organization was going to remain un-nationalized there would have to be a livening up in the management, and at the same time a recognition that it was an alternative trading concern, and a trading concern that must stand side by side with other trading concerns and other forms of transport.

MR. T. W. WYATT said the chief thing which struck him in the paper was the absence of any reference to the effect of falling prices on the position of the railways. The paper was otherwise admirable, but this was a serious defect. Sir Josiah Stamp had often pointed out and given warning of the effect of falling prices and his prophecy had been only too true.

On p. 384 it was pointed out that the replacement value based on existing assets was about 46 per cent. in excess of the capital expended. Falling prices would quite upset that calculation. On the same page it was pointed out what a great amount of capital was

necessarily involved in the provision of a railway system, the fixed nature of the investment, and the preponderance of overhead charges. It was obvious that in view of these three items, falling prices would have a great effect on the railways and it would have been useful if Dr. Fenelon had given some idea of what the effect had been together with the general deflation of salaries, wages and profits.

The distribution of capital expenditure on the railways was also given on p. 385, and showed the large amount of capital necessarily involved and the high proportion of fixed assets. These assets were valued on a basis of price but tremendous variations had taken place and this important feature seemed to have been overlooked.

MR. WILLOX said he would like to draw attention to Table II of Dr. Fenelon's paper, in which the railway capital was set forth. The nominal capital value amounted to about £1,200 million, the capital charges upon which represented a heavy burden on the railways. That was a very important figure, and if it could be wiped out the railways might become prosperous again. It was worth considering how these figures of capital value were built up. It was generally thought that capital was built up out of savings. If that were so it must be assumed that such an amount of money as £1,200 million existed before the railways came into existence. Considering the capital values of all the industries of the country, was it reasonable to suppose that, say 100 years ago, the large amount of money which was represented in the form of capital existed? It seemed quite obvious that it did not, and therefore there must be some flaw in the argument that capital was built up out of savings. If that were so, how was capital built up? It seemed obvious that money must be created, and as a matter of fact it was generally agreed that that was so, no less an authority than Mr. McKenna having repeatedly explained how it was created. He said that the amount of money in existence varied with the action of the banks in lending money and calling in loans. Every bank loan created a deposit, and every repayment of a loan destroyed an equivalent deposit; therefore it might be said that all debt and all capital values were built up by the same process—by the lending of money by the banks. The original financing of new railways must have come from bank loans, and as they were repaid to the banks, they were cancelled out of existence, but they always left behind them figures of capital values. This was an important matter which received scant consideration at the present time, and it was a curious thing, that if this theory were true, the real assets of such wealth-producing items as railways were represented by debts. It might be said that all real capital assets were represented by figures of debt, but that was an inversion of the truth. If the true nature of the burden under which the railways—in common with all other industries—were labouring, lay in this direction, it would seem well worthy of careful investigation, and there existed no more suitable body at the present time to carry out such an investigation than the Royal Statistical Society.

MR. M. F. BARNARD said he agreed with the previous speakers that Dr. Fenelon had provided a good compendium for students of railway statistics. There were, however, one or two points that might be elaborated.

No reference was made to the fact that when railway rates were increased in September 1920 to 100 per cent. above pre-war level, the Companies were actually receiving deferred payments, because the Government had decided that the railways were to be maintained on a self-supporting basis, and a deficit on the working of the railways at the rate of 54 million pounds per annum which had begun to accrue on the 1st April, 1920 was required to be made good by the end of July 1921. In other words in the eleven months between 1st September, 1920 and the 31st July, 1921, rates had to be increased to a level which not only met expenditure incurred during that period but cleared the deficiency which had accrued during the previous five months, *i.e.* from the 1st April, 1920 to the 31st August, 1920.

With regard to the effect of tariffs, there seemed to be a little apprehension that tariffs might localize traffic and be worse for the railways. If it were borne in mind that a larger home trade might be created, causing raw materials to pass over the railways to a greater extent, the balance should be in favour of an increased traffic for the railways rather than a diminution.

Reference had been made to the old question of classification. It was, however, not so antiquated as one was led to believe. Too much stress had been laid on "the value of the commodity." Other items had to be considered, such as bulk in comparison to weight, risk of damage, cost of handling and saving of cost when forwarded in large quantities, to mention four out of the five criteria specified in Section 29 of the Act of 1921.

There was a great deal of food for thought in the series of figures in the paper, and Mr. Barnard said he had been very interested in analysing the statement regarding train-miles. The author held that there had been an increase of 5 or 6 per cent. in train miles for 1923-31. On analysis it was interesting to find that there was an increase of 19 million train miles with regard to passenger traffic, and a decrease of 41 million with regard to freight traffic, indicating that in the one case, owing to public requirements, economies could not be effected so readily as in the other. Taking the 1913 figures as a basis it was interesting to notice the increase in passenger train receipts per train mile was considerably less compared with freight train receipts, indicating that if there was any relativity, the freight traffic had been paying more than its share towards the upkeep of the Companies.

Mr. Barnard said he had not only found the statistics a matter of having a quarry to go to, but also an arsenal, because whatever combinations were put before the railway companies, they always found some adventitious circumstance with which to discount the figures.

With regard to the question of "regulations," in spite of what Sir Josiah Stamp had said regarding the desire of the Railway

Companies for these regulations to be removed, in at least one instance the Railway Companies were written to and asked in what direction they would like the regulations removed, and they replied that they would rather stand by the Salter Conference and see the road traffic regulated. That was rather at cross purposes to what Sir Josiah Stamp had said.

Mr. Barnard said he would like to support those gentlemen who had already spoken, in saying what an excellent paper had been given by Dr. Fenelon.

MR. JOHN QUIREY said that reference had been made to the fact that since the amalgamations had taken place the Railway Companies had insisted upon the payment of charges in advance. That was only true with regard to one portion of their traffic—the parcels traffic conveyed by passenger train; it was not so of traffic carried by goods train.

It was interesting to him to hear that Railway Companies could raise charges to obtain their Standard Revenue; he did not think the speaker could have read the judgments delivered by the Rates Tribunal in the last four years and still hold that view.

With regard to railway capital, it seemed to be the view of one speaker that railway capital was written up or down according to current price level. The amount of capital expenditure was largely at pre-war prices and first-construction prices. Any increase to the capital expenditure of the Railway Companies represented improvements or additions at the then current prices.

The following comments were received in writing :—

MR. SAMUEL CHAPMAN: The Paper so completely covers the various aspects of our English Railways, that it would be impossible to discuss the whole of it within reasonable limits. I will therefore confine myself to the following points.

I venture to suggest that Tables IX, X and XII, while requiring a considerable amount of labour to compile, do not materially increase our knowledge of what is going on in regard to passenger traffic.

The statement that the average distance travelled has increased from 13·96 miles in 1923 to 15·32 in 1930, while to some extent explained by road competition taking away a great deal of the short distance traffic, is also partly caused by the large drop in the number of workmen's tickets and it would seem that, in order to form an intelligent judgment, the statistics require further sub-division.

The average fares on the Great Western and L.M. & S. Railways for 1930 and 1931 are :-

				G.W.		L.M. & S.	
				1930.	1931.	1930.	1931.
First Class	...	...	...	9/6-67	9/10-50	6/9-82	6/7-37
Third Class	...	...	...	1/6-63	1/6-49	1/5-54	1/5-00
Workmen	...	...	...	2-70	2-73	3-13	3-17

In each case, numbers have decreased in 1931, also third class average fares, while on both lines, workmen's fares have increased, but the first class average has decreased on the L.M.S. and increased on the Great Western.

Tables XIII and XIV are interesting, but would be more illuminating if workmen's fares were excluded and the other columns subdivided into first and third.

Requirements vary so much in different areas that, while it may be admitted that the passenger tariff has become very complicated, I am afraid any attempt at simplification by all-round standardization would be disastrous for railway shareholders and unpopular with the public in many districts.

I have elsewhere suggested that as the parcels traffic is holding up very well, it may be possible to devise something for small consignments by goods train, which would suit traders by giving accelerated delivery, at an increased rate from the ordinary goods rate, but less than parcels charge.

In Table XXVIII, it would appear that Perth is twice included, and that the total number of Hotels should be 80. The Table would be more informative if land and houses were divided as shown below for the G.W. and L.M.S. Companies.

	L.M.S. Acres.	G.W. Acres.
Agricultural	9,141	3,289
Urban and Suburban	2,631	1,660
	11,772	4,949
Labouring class dwellings	1,940	305
Houses and cottages for Company's servants ...	12,067	2,163
Other houses and cottages	11,341	1,395
	25,348	3,863

The total number of acres of land held by the L.M.S. Company as compared with the G.W. is within measurable distance of the ratio of route miles, but an analysis discloses the relatively large amount of agricultural land out of the total held by the former Company.

With regard to operating statistics, there has been so great an increase in locomotive efficiency in recent years, that "engine-miles" cannot usefully be compared if lumped together for all Companies. On both sides of the Atlantic, very large sums are expended by the railways in getting out statistics of engine-miles, train-miles, and car-miles, and by Government Departments in collating the figures, which, in bulk, serve no useful purpose. If it be considered essential that such information be compiled for the information of the public (it would be interesting to have the percentage of the population of the United Kingdom and of the United States availing themselves of the mass of figures prepared for their study) why not go a step further and evolve for statistical purposes "standard" locomotive, train, car, and mile of line with + or - for deviation from "standard"?

MR. J. E. ALLEN : I regret very much that I cannot accept the invitation to take part in the discussion personally, so I submit certain observations in writing. First, I am grateful to Dr. Fenelon for his selection from so large a mass of statistics for presentation in a small space. In general I agree with his exposition. But I think he might have pointed out how entirely inadequate was the "compensation" of £60 millions which the railway companies obtained from the Government "for war time arrears and maintenance and repairs and other consequential damages." What really happened was this:—In August 1914 the Government took over a business which yielded a net return of £50 millions a year; at the end of the "control" period it handed back the business in a disorganized state with its profit-making capacity almost gone. For this very real loss the railway shareholder received practically no compensation.

My second point is the enormous cost of the permanent way, stations, etc. Would Dr. Fenelon agree with my proposition that "in all forms of land transport (road, canal or railway) the main item of cost is not the vehicle and its propulsion but the permanent way"? Hence the ability of the road motor vehicle, either goods or passenger, to quote rates and fares which are below those charged by the railways. It can do so *only* because it is permitted to throw a large part of its running costs, *i.e.* the construction, maintenance, lighting, signalling, and policing of its permanent way on the ratepayer. In the case of some of the biggest and most destructive road vehicles, *e.g.* a lorry weighing ten tons unladen drawing a trailer half its size, and using steam, heavy-oil, or town gas, the total payment for the use of the road is only £54 if it has pneumatic tyres, or £66 if it has hard tyres. It would pay the same if it weighed five tons. Thus at present the duties paid for commercial motor licences are like an income tax which should take 5s. in the pound from a clerk, 2s. 6d. from his employer, and 6d. from a millionaire. The present scales of licence duty were bound to encourage the use of the heaviest and most destructive vehicles.

All this is strictly relevant to a consideration of British railways since the war, seeing that their deplorable financial condition is largely due to road competition which has been subsidised by the ratepayer and encouraged by the Ministry of Transport. To divert traffic from the railways to the roads is a misuse of our national resources. I do not deny the superior convenience of door-to-door transport which the road motor offers; but this convenience is a thing worth paying for.

Moreover, while road competition has undermined the financial position of railways in France, America, and other countries (I think it is worked under special restrictions in Germany), there is a special factor operating in this country. In effect the Railways Act of 1921 makes the trader and the traveller the senior partners of the railway shareholder. (Possibly the Chancellor of the Exchequer and the local rating authority could also be ranked as senior partners.) I say this because under the presumed bargain the railway companies undertake to carry all the traffic offered to them, whether goods or passengers, in return for the net revenue of 1913,

together with one-fifth of any surplus. If the standard revenue is exceeded, they must give back 80 per cent. of the excess to the public in lower charges. In other words the Excess Profits Duty is to be applied to the railway companies, and to them alone, in its severest form.

As a matter of fact the standard revenue has never been attained, so this provision has not worked. But the Act failed to provide for a decline in traffic due to the depression of trade which was likely to follow the post-war boom, except by the method of raising rates and fares, which is inapplicable when other prices are falling.

Another point generally overlooked is that railways, unlike other concerns, are rated on their actual profits. So again the community has a direct interest in the financial prosperity of the railways. I am aware, of course, that the rating relief under Mr. Churchill's derating scheme has to be passed on in the shape of rebates on certain kinds of heavy traffic. Dr. Fenelon notices the enormous increase in the railway wages bill, which is out of all proportion to the increases obtained by workers in other industries. This is a direct result of Government control. As the Government did not feel obliged to maintain any definite relation between revenue and expenditure, it could give increased wages to railway men without asking traders and travellers to pay higher rates or fares. Another point taken by Dr. Fenelon is the unfairness of the "workmen's fares" imposed by Parliament on the railways, while omnibus and coach companies are left free from a similar obligation. Yet it would be more equitable to impose such a condition on transport companies using the public roads by licence, than on those using their own tracks. I am not sure that there is any economic justification for imposing the obligation to sell a service, or a commodity, at less than its fair price to certain persons, except in return for some concession from Parliament roughly equivalent in value. These fares, I may add, are not, and cannot be, confined to workmen; I have sometimes travelled with a "workman's ticket," but never on my way to work.

Dr. Fenelon refers to the effect of road competition in destroying the basis on which the charges for goods traffic have been built up. Railways are supposed to charge "what the traffic can bear," *i.e.* they make the expensive stalls and boxes pay for cheap seats in the pit. This is a distinct gain to the community, which needs cheap transport for its heavy and bulky goods. But the road vehicle charges according to the "cost of service," and thereby attracts from the railways the highly-rated traffic. I doubt if the small saving in the transport costs of such goods ever reaches the ultimate consumer. It is too small to be passed on over the counter.

I agree entirely with Dr. Fenelon's views on main line electrification, at least in a country like our own which has ample supplies of good coal. Moreover, the Diesel-electric locomotive has possibilities which cannot yet be estimated. I shall be very sorry to see our railways as well as our Navy dependent on fuel brought from distant countries over which we have no political control.

It may be a difficult question to answer:—What is the real cost of transporting 1000 tons of goods, or 10,000 passengers, from

London to Birmingham, by railway and by road respectively, when all the charges of and incidental to the rival forms of transport have been calculated? Until the proposals of the Salter Conference, or something not unlike them, have been adopted by Parliament, we cannot tell by experience what are the relative costs of transporting goods and passengers by rail and road respectively. At present it is quite clear that road transport is subsidised by the ratepayer, since at least £40 millions out of the £60 millions annually spent on our roads must be debited to the heavier motor vehicles. Moreover, since the use of the roads by motor vehicles of all kinds—cycles, cars, coaches, omnibuses, and lorries—differs both in kind and degree from the use of the roads by horsed vehicles in the pre-motor period, I hold that the taxpayer and the ratepayer are entitled to a payment for the use of the roads as well as a repayment of the money spent on them. Further, the enormous casualty list—some 6,000 deaths and 150,000 injuries every year—is part of the cost of road motor transport, though it cannot be assessed in terms of money. If the provisions imposed upon the railways by Parliament to secure the safety of the public were imposed equally upon road motor vehicles, motor traffic as we have it to-day would cease to exist. I contend that the poorer members of the community, *i.e.* those not rich enough to own a motor of any kind, have a very real grievance against those who have driven them off their roads and diminished the amenities of their lives.

MR. H. G. LEWIS: Dr. Fenelon's paper contains much that appears to call for an early amendment of the "standard revenue" and rates and charges provisions of the Act of 1921. The virtual monopoly envisaged by these provisions has disappeared and it is unlikely that trade recovery, even on a large scale and combined with the utmost economy in operation, would enable the standard net revenue to be achieved. Further, a recent application to the Railway Rates Tribunal for consent to a "flat" rate covering an important traffic was refused on the basis of the Act.

Dr. Rhodes has demonstrated the danger of averages isolated from the relevant statistics. It is equally important in many cases to consider also the relevant costs, particularly in such instances as the locomotive statistics quoted from Mr. E. J. H. Lemon's paper before the Institute of Transport. It would be possible considerably to extend the mileage between general repairs of a locomotive by carrying out more frequent repairs of a lighter nature, the total cost of which, together with that of the ultimate overhaul, might result in an increased repair cost per mile run. In practice, repairs are classified, and from a statistical point of view it may be interesting to state that a survey of the general condition of a stock of locomotives can readily be obtained from frequency tabulations of the engines according to mileage run since last repair and mileage between repairs. If this is taken out at six-monthly intervals in groups of, say 5,000 miles, and average standards can be fixed, the mean dispersion coefficients of these series over a number of periods should provide useful indices of maintenance.

Operating economies generally are not so easily effected as some railway critics appear to believe. The organization, although widespread and often apparently unwieldy, is at the same time a balanced machine and what may appear to be economy in one direction may result in increased expense or mere loss of revenue in another. Except in minor cases, true economies can be indicated only by a close study of the co-ordinated departmental costs and statistics and these are receiving ever increasing attention. Incidentally considerable economies have been obtained in the preparation of the figures themselves by the rapidly extending adoption of mechanical tabulation.

MR. BARNARD, in supplement to his remarks made at the meeting, drew attention to the statement with regard to the decrease in the size of consignments and the increase in small parcels carried by the Railway Companies. He did not think this was accounted for entirely by the smaller requirements or stocks of the retailer, but reflected to a large extent the habit of certain traders of sending consignments of a lorry load or more of the higher classed traffics by road and the smaller consignments or parcels by rail.

If this were so, he submitted that it bore out his suggestion that classification was a matter of concern to the road haulier as well as to the Railway Companies because the former based his charge, generally speaking, on the cost "per vehicle-mile," and hence obtained the carriage of the vehicle load (*i.e.* truck load equivalent on road); the Railway Companies being left with the smaller consignments and parcels which would fail to make up a minimum vehicle load, upon which the Road Company based their charge.

DR. FENELON in reply, said: As it is getting late and there are only a few minutes left me in which to reply, I will now merely deal briefly with a few points which have arisen and later elaborate my remarks for the printed reply in the *Journal*.

In the first place, I am greatly indebted to Sir Josiah Stamp and Dr. Rhodes for their kind remarks in proposing the vote of thanks and I thank you all for the friendly way in which you have received the paper. I am glad that Sir Josiah Stamp emphasised the importance of considering post-war railway problems in connection with a dynamic and not a static background. The post-war period has been a transitional period for British industries and trade. At the same time as British railways have been improving their organisation and introducing various technological improvements, economic conditions have also been shifting and changing. Dr. Rhodes has pointed out that railway operating statistics must be used with care. That is undoubtedly true and, like all statistics, they have to be considered in relation to what they represent, how they are obtained, and what limitations are involved. As Mr. Kirkus said later, a railway manager would no doubt review the statistics as a whole and not look at one figure in isolation.

Mr. Kirkus also referred to statistics of railway accidents. I am glad that this aspect has been brought up and I would like to join

with him in his tribute to the remarkable safety of British railways. I fully agree that the financial position of British railways would have been much worse but for the amalgamations effected in 1923, which enabled many economies to be obtained. The position, moreover, would have been extraordinarily difficult for the railways if 214 different companies had had to face acute road competition each in a small area of its own.

I cannot quite agree with Col. Waley Cohen that the railways have not shared at all in the greater prosperity of the South as compared with the industrial North. He also referred to the greater convenience of road transport, and it is undoubtedly true that for certain kinds of traffic road transport is more convenient than rail, though in this connection the new coptainer, railhead, and similar services which have been introduced during the past few years, should serve to increase the competitive power of the railways.

Mr. Wyatt raised the question of the effects of falling prices. It is true that much railway expenditure is relatively inelastic, and hence a fall in general prices would adversely affect the railways. On the other hand the reduction in the price level has enabled the railways to effect certain economies in the purchase of materials. Some part of the total savings of £28 million recorded between 1923 and 1931 has been due to this cause but, as there is no special index number available to show fluctuations in the cost of railway materials, it is not possible to give an exact indication of the proportion of the savings so due. There have also been some reductions in wage costs, since wages were based on a sliding scale adopted under an agreement negotiated with the trade unions in March 1920. For each Conciliation Grade a standard or "B" rate was fixed at 100 per cent. above average pre-war rates, together with a current or "A" rate representing the standard rate plus the then existing bonus of 33s. per week. The "A" rate was subject to variations according to changes in the Ministry of Labour's Cost of Living Index Number on the basis of one shilling change in wages for each variation of 5 points in the Index Number. In no case however, were wages to fall below the standard or "B" rate. This agreement remained in force till 1931, when earnings were subject to a 2½ per cent. deduction with a further 2½ per cent. reduction in respect of all earnings in excess of 40s. per week. At the same time certain modifications were also made in overtime rates and conditions of service. It was however provided that male adults whose basic rates were under 41s. per week should not receive less than their basic rate, and in no case was the deduction to exceed 6s. per week.

As regards railway capital costs, it should be remembered that the greater part of railway capital was raised in pre-war days by means of public subscriptions. The method adopted in showing the amount of railway capital is based on what is known as the Double Account System. This indeed is a statutory requirement and the actual form of the accounts is prescribed in detail by various Acts of Parliament. A similar system, it may be noted, has been applied to other enterprises, such as canals, waterworks, and gas companies, where the capital is contributed for a specific purpose partaking of

a permanent character. In the Capital Account—which deals with the fixed or permanent assets and the Capital and Debentures subscribed—the assets are not written down but appear therein at cost. No revaluation or readjustment of the assets is allowed. A Reserve Fund Account or an Insurance Fund might be created out of profits and debited against the Revenue or Profit and Loss Account and this is done for example by certain gas companies. Trust-owned ports are required to set aside out of revenue one per cent. per annum for purposes of capital amortization and it has been suggested that this principle might well have been applied to railways. Mr. Willox has raised the question of capital reconstruction but this is rather a big problem to tackle in a short reply. No doubt if a reduction in prior charges could be effected it would benefit the junior stocks and might enable additional capital to be more easily obtained, but the matter is complicated by the fact that the prior stocks are, or were, trustee securities and the investments were presumably made because of the security offered.

I am indebted to Mr. Quirey for answering several questions raised in the discussion. As he has pointed out, it is only in the case of parcels traffic carried by passenger train that the companies have insisted on payment in advance. A stamp system of prepayment has been adopted, which has greatly simplified the clerical and accounting work involved and saved a great deal of expense.

Mr. Chapman suggests that certain of the tables might have been further subdivided. I should have liked to go into greater detail but I hesitated to add to the length of the paper. Mr. Chapman also queries the total number of hotels owned or worked by the railways. The number 81 is correct; the explanation being that the total figure in the last column of table XXVIII includes railways outside the four groups. The additional hotel is at Mumbles (South Wales Transport Company) and though this is rather in the nature of a refreshment room, it is classified as a hotel for the purposes of the Accounts and Returns furnished pursuant to the Act of 1911.

Mr. Allen raises the question of the proportion of cost due to the permanent way. On British railways somewhat over 80 per cent. of the capital expenditure on the railway proper (that is apart from ancillary enterprises) has been incurred on the permanent way and buildings, while of the annual expenditure about 14 per cent. is required for the maintenance of the way and works. In the case of canals, it is obvious that by far the greatest proportion of the capital cost is due to the construction of the waterway, locks, reservoirs and pumping machinery. No exact figures are available for the total capital cost of road construction and it will be remembered that the Salter Committee were not able to determine any exact monetary equivalent of the "legacy of the past" though they considered that it might be fairly set off against the "community use" of the roads.

Mr. Barnard has correctly pointed out that classifications are also applied by road transport concerns, since they must take account of various factors which affect their costs. Railways, however,

have based their tariffs in the main on the value of the commodities. Cost of service has only been a subsidiary factor. This method has enabled them to carry low-grade commodities, such as coal, ores, or iron, at low rates and in this way they have provided cheap transport for the raw materials of many of our industries. It is significant that many firms which distribute their product entirely by road still use the railways to carry their coal and other raw materials. Should the railways' system of classification break down, the rates for low grade traffic would probably have to be raised.

In conclusion, I should like again to express my grateful thanks for the very kind way in which my paper has been received.

As a result of the ballot taken during the meeting the following candidates were unanimously elected Fellows of the Society :

Victor Percival Augustine Derrick, F.I.A.

Alfred Henry Spaul.

B. Vedantasingar, B.A.



PUBLIC EXPENDITURE AND TRADE DEPRESSION.

By R. G. HAWTREY.

[Read before the Royal Statistical Society, April 25th, 1933, the
PRESIDENT, the RT. HON. LORD MESTON of Agra and Dunottar,
K.C.S.I., LL.D., in the Chair.]

I. *The Meaning of Trade Depression.*

THE Royal Statistical Society is so familiar with the position of Government servants speaking in public that it is hardly necessary, except for purposes of record, for me to explain that what I have to say will express only my personal views and is not to be associated with my official position in the Treasury.

In the controversies arising from the present economic crisis the question of expenditure by public authorities has figured prominently both in this country and elsewhere. The undertaking of a programme of public works with a view to "giving employment" has been extensively advocated, and is indeed the favourite proposal of those who think that "something must be done." And at the same time the decline in the yield of public revenues has raised the questions of budget deficits, heavy taxation, and economy in public expenditure in an acute form.

I propose to examine the economic principles involved in these questions, and to show what is the bearing of measures for raising and spending public funds upon the problem of escaping from the trade depression.

I must start with some preliminary remarks about trade depression. I should define trade depression primarily as a *shortage of demand* in terms of money. Producers, unable to sell their output at remunerative prices, produce less and sell at lower prices. There results a decline in profits and in employment. The total of incomes in terms of money, the "consumers' income," as I call it, shrinks in a proportion compounded of the fall of output and the fall of prices.

Now the consumers' income is the source of demand. If we give the name "consumers' outlay" to what is spent out of income, whether on goods, services or securities, then demand practically *is* the consumers' outlay. Any expenditure which is not out of income, representing either a transfer of capital from one holder to another or a transfer of goods from one intending seller to another, is not ultimately demand at all.

The shortage of demand that arises at a time of depression may be described simply as a shrinkage of the consumers' income and

outlay. Incomes are derived from production; they are paid out of the proceeds of sale of the goods and services produced. The shrinkage of the consumers' income is itself the result of the shrinkage of these proceeds of sale. The shortage of incomes results from the shortage of demand, and the shortage of demand results from the shortage of incomes.

That is the vicious circle of deflation. The problem of escaping from the depression is the problem of breaking the vicious circle. From the single cause of the shrinkage of the consumers' income there flow all the well recognised characteristics of depression, unemployment, the vanishing of profits, the embarrassment of debtors, the fall in the yield of tax revenues. If by any device additional incomes can be created, they bring with them additional demand and therefore additional production, which in turn means additional incomes.

When this process is set in operation, the enlargement of money incomes takes the form partly of a rise of prices as well as that of an increase of production. Consequently the volume of employment does not increase quite in proportion to the consumers' income. The difference is accounted for by a reinstatement of profits. At a time of depression profits are below normal; they are less than the normal proportion of the consumers' income; in fact it is because industry has become unprofitable that it is under-employed.

Equilibrium might be regained by a reduction of wages, without any enlargement of the consumers' income, provided prices did not fall further, for industry would thereby be made remunerative, and profits would once again supply an adequate motive for enterprise. But the reduction of wages is an alternative outside the scope of our present subject. What we are concerned with is the prospect of breaking the vicious circle of deflation by way of an enlargement of the consumers' income.

II. *Government Expenditure and Consumers' Income.*

I turn next to an examination of the relation of public expenditure to the consumers' income and outlay. Government expenditure is ordinarily met through taxation from the incomes of the people. Taxation forms part of the consumers' outlay; it is so much as is provided out of income for the services and expenses of Government. At the same time Government expenditure gives rise to a group of incomes, those derived from rendering services to the Government or selling things to it, together with the interest on the national debt and the pensions and benefits paid from public funds. This group of incomes will tend to be equal to the public revenue from taxation and other sources. They will not be exactly equal,

for there will be capital transactions; not only will the Government probably on balance either borrow or repay debt, but the traders from whom the Government buys may be modifying their working capital. But for our present purposes we may assume them to be equal.

Suppose the consumers' income to amount to 100 millions of currency units a month. Let the revenue from taxation be 10 millions, and let the expenditure of the Government and the group of incomes derived from that expenditure be the same. Then the consumers' outlay is composed of 10 millions paid in taxes and 90 millions spent on marketable products. "Marketable products," it should be explained, are to include *all* objects of expenditure other than the services of the Government, not only commodities and services, but also securities, the investment market being regarded as a channel for directing savings out of income into capital outlay. The consumers' income is composed of 90 millions derived from the production and handling of marketable products, and 10 millions from the Government.

Now suppose that the Government expenditure and taxation are each increased from 10 to 11 millions a month. If the increase occurs at a time when the productive resources of the country are fully employed, the additional services required by the Government can only be provided by diverting productive power from other purposes. The outlay on marketable products and the incomes derived from them must both be reduced from 90 millions a month to 89.

But if at the time the country is not fully employed, it is possible for the additional million of Government expenditure to provide new incomes to the amount of a million without encroaching on existing employment. The extra taxation, it may be said, will diminish by a million the resources which the taxpayers have to spend on marketable products, but there is a new contingent of taxpayers, for the new incomes created by the Government expenditure will reinforce the pre-existing taxable incomes, and it would seem that the sum spent on marketable products will remain undiminished at 90 millions. The consumers' income will have been increased from 100 millions to 101 millions, and the amount of employment given will have increased accordingly.

This is a perverse result! For no one wants to prove that a Government can increase employment by increasing taxation. And indeed it is easy to put the sequence of events in a different light. Suppose that the Government starts by imposing taxation, and reducing the resources of the taxpayers from 90 millions a month to 89. The incomes derived from supplying marketable

products will be thereby reduced to 89 millions, and, till Government expenditure begins, the consumers' income will be reduced to 99 millions a month. The new incomes derived from the Government expenditure will do no more than restore the consumers' income to 100 millions, and will leave the incomes derived from the supply of marketable products at 89 millions.

Which analysis is correct? I do not think any theoretically certain answer is possible. We cannot even say that it depends on whether the imposition of the new taxes precedes or follows the engagement of the new Government employees, for we cannot know precisely what the time lag will be between the imposition of the taxes and the consequent diminution of the taxpayers' expenditure or between the engagement of the employees and the consequent increase in their expenditure. But clearly, whatever these time lags may be, it would be possible, by postponing the taxation sufficiently, to ensure the expenditure taking effect first.

That will mean that the Government must borrow temporarily for the interval of time before the new revenue comes in.

III. *Government Borrowing and Inflation.*

But of course the universal assumption is that schemes for giving employment through Government expenditure will be financed by borrowing of a permanent or long-term character.

Let us then assume that that is the course followed. The Government issues loans to raise the funds for the additional expenditure of a million currency units a month. But if the loans are issued by the ordinary procedure through the investment market, they will presumably be subscribed *out of income*, just as much as if the money had been raised by taxation, and the same question arises as to which comes first, the decline in demand for marketable products arising from this diversion of income, or the increase in demand arising from the Government outlay.

The investment market is the channel through which savings are made available for capital outlay. New issues of securities are brought out to meet the cost of new capital outlay, and it is the function of the market to equalise the new issues with the available supply of savings (allowance of course being made for the savings applied to capital outlay without the intervention of issues of securities).

Long-period equilibrium is secured in the market by the establishment of a rate of interest sufficiently deterrent to keep new capital outlay within the appropriate limit, but over short periods the market relies on more direct methods. An excess of new issues is felt through dealers (among whom are to be included the under-

writers of the new issues) being overloaded with securities which have to be held with borrowed money. Under such conditions not only do the prices of securities fall, but the terms specifically attaching to new issues are made more onerous, and some new issues, to which the market is expected to be specially unfavourable, are refused altogether.

Thus the investment market is to be regarded as limited in capacity. If offered more securities than it can take, it will reject the excess. If the Government draws upon the investment market's resources, there will be so much less left for other purposes.

But there must be a considerable interval before the effect of the diversion of investible funds to the Government is felt in a slackening of the capital outlay undertaken by private enterprise. Capital flotations usually require a long preparatory period of planning, and, when the investment market becomes unfavourable, those which can be postponed or abandoned without excessive loss are for the most part still in an early stage, and would not have involved actual outlay till months later.

In the ordinary course the Government's own capital outlay would also involve an equally long preparatory period. But that can be avoided if the actual issue of the loan to raise the money is deferred till the project is ready to start.

It will be observed that the essential condition of the Government expenditure having a favourable effect is that the raising of money out of income, whether from taxpayers or from investors, should come at a sufficiently late stage. And it is easy to see why. The expenditure is then made in the first instance *by a creation of credit*, and there is for the time being a clear addition to the consumers' income and outlay. That addition enables money to be raised by tax or loan without diminishing the outlay on marketable products. The Government expenditure of 1,000,000 units a month increases the consumers' income to 101,000,000 and the outlay on marketable products to 91,000,000.

Left to itself, the increase in demand would bring about an increased output of marketable products, a further increase in consumers' income and in demand, and so the full operation of the vicious circle of inflation. The raising of the money from consumers reduces the outlay on marketable products to 90,000,000 again, and so restricts the additional incomes to 1,000,000.

Thus the Government expenditure is a vehicle of inflation. And it is open to the obvious criticism that any such vehicle is superfluous. It is the inflation that causes the enlargement of the consumers' income, and the inflation can be started by suitable measures

of credit relaxation without being associated with any Government expenditure.

Nevertheless that does not altogether dispose of the matter. Certain further arguments need to be considered.

IV. Mr. Keynes on "Investment."

In the first place I must refer to the position of Mr. Keynes, who has in recent years been a persistent advocate of Government expenditure as a means of relieving depression. In his *Treatise on Money* he gives the name "Investment" to so much of the output of the community per unit of time as is not disposed of to consumers, or, more briefly, investment is "unconsumed output" per unit of time. Employment varies with output, and therefore, if consumption be assumed not to change, an increase in employment means an increase in investment. Investment in working capital or in stocks of commodities Mr. Keynes believes not to be sensitive to the rate of interest, and, *if that is so*, then the only factor that can be modified by credit regulation is investment in fixed capital.

Now credit regulation proceeds primarily through the short-term rate of interest, and therefore, Mr. Keynes would say, to dispel a depression, it is necessary to wait for the short-term rate of interest to affect the long-term rate and then for the long-term rate to affect the amount of capital outlay. That must be a slow process, and, if everything depended on an increase of expenditure on fixed capital, the intervention of the Government to effect such an increase would be justified.

Its intervention would have to be such as to bring about a real net increase. In so far as the Government's capital outlay merely takes the place of an equivalent amount of capital outlay by private enterprise, nothing is accomplished. The Government's outlay must not be on objects which private enterprise would otherwise undertake, and it must therefore be confined to those which either do not promise a revenue sufficient to cover interest, or, if revenue yielding, are legally or practically Government monopolies.

Further, even when these conditions are fulfilled, the Government must not encroach on the supplies of investible funds available for private enterprise. When the Government issues loans and draws on the resources of the investment market, the market becomes less favourable to other new issues. If the long-term rate of interest rises, and the reluctance of the market is made effective, the progress of revival through the reaction of credit relaxation on the investment market will be delayed.

In fact what is really needed is that the Government finance its capital outlay by a creation of credit, and that the central bank

cooperate by allowing a credit expansion to occur. We must suppose the creation of credit for the Government to be employed to hasten the effects of a credit expansion which the central bank is in any case trying to induce.

The Government will presumably raise money by the issue of short-dated securities, such as Treasury bills, to the banks, and the central bank will itself buy securities with a view to increasing the cash reserves of the banks and so inducing them to take the Treasury bills without restricting the accommodation they grant to traders.

V. *Commercial Borrowing.*

Mr. Keynes's argument depends primarily on long-term investment being the only part of business which is sensitive to credit regulation. And here I cannot help thinking that his use of the word "investment" to mean unconsumed output has gained, from readers of the *Treatise* and possibly from Mr. Keynes himself, a readier assent to that view than it really deserves. For in ordinary usage investment means long-term investment, and does not include commercial borrowing at all. The purpose of a very great part of bank advances and especially of bills is to enable traders to carry stocks of commodities in the interval between purchase and sale or between purchase and use. There are of course bank advances to finance goods actually in course of manufacture or in transit, and these advances cannot easily be contracted or expanded except as a *result* of decreased or increased activity. But the commodities reposing in stock in marketable form invariably account for a very large part of the credit facilities required in any highly developed community, and any trader's holding of these commodities can be varied within wide limits with very little inconvenience to him. This applies not only to the finished goods in the hands of retailers and wholesale dealers, but also to the materials and intermediate products awaiting use in the hands of manufacturers. All alike are in a position to delay their purchases whenever the charges for borrowing money are raised, or their bankers show in other ways a reluctance to lend. And, when the economic system is working normally, a reduction of charges and a relaxation of credit would meet with an immediate response in a hastening of purchases, and a consequent stimulus to productive activity.

If we seek numerical data indicating the magnitude of these stocks of commodities, the statistics of balance sheets appended to the American income tax returns afford some enlightening information. The "inventories" of those manufacturing and commercial companies which furnished their balance sheets for 1928 amounted to \$18,000 millions, and their short-term indebtedness to \$13,000

millions. The returns cover the great majority of corporations subject to tax, but they entirely exclude private firms and partnerships. It may be mentioned that business and partnership incomes accounted in 1928 for \$5,174 millions in the individual income tax returns, though we cannot say how much of this represented manufacturing and commercial concerns. Manufacturing and commerce accounted for \$5,991 millions out of \$10,618 millions of income from corporations.

The goods actually undergoing a process of manufacture, in the loom or on the lathe, could only form a very modest proportion of the total. It is clear that the amount of goods in marketable form held in stock must have been very great. A relatively small change in the total, if made over a short period, would have an enormous effect on production. If traders sought to increase their stocks by \$500 millions, and the effect on industry of the additional orders given were concentrated in one month, the consequent increase in production would be at the rate of \$6,000 millions a year, or, say, 7 per cent. of the national income.

When production is stimulated in this way, through traders being led by easy credit to hasten their purchases of goods, there is not necessarily any considerable increase of "investment" in Mr. Keynes's sense of unconsumed output.

The traders who order increased consignments of goods do so, no doubt, because with easier credit they are *willing* to hold larger stocks. But the increased activity generates increased incomes and increased demand. Sales increase nearly as fast as output, and the actual increase in *unconsumed* output may be very small or even non-existent.

To say that commercial borrowing is sensitive to credit conditions is not to deny the sensitiveness of the investment market altogether. But the response of the investment market is necessarily much slower. When the banks relax credit, they offer an inducement to investors, speculators and stockjobbers to hold more securities with borrowed money. That makes the investment market more favourable, and so tends to stimulate new issues. But the stimulus to economic activity is not felt till the capital outlay arising out of the new issues actually begins, and that is likely to be after a long preparatory period.

Theoretically the Government can, with suitable organisation, start capital outlay with less delay. It can prepare plans for a selection of projects in advance of actual needs, and can then, as soon as the occasion requires, put them in hand as fast as contractors can be selected. But in practice plans prepared some time beforehand are almost certain to require reconsideration and adaptation.

All that can be expected is that the Government may stimulate capital outlay a little in advance of the response of the investment market to easy credit. It is still likely to lag far behind the response of commercial borrowing, which in the absence of specially unfavourable conditions should be almost instantaneous.

The promptitude of the response is of decisive importance. In virtue of the inherent instability of credit, revival once started tends to gather impetus. Provided the corner is really turned, a very modest movement will soon be amplified to any required extent. The stimulus to commercial borrowing may ordinarily be relied on to turn the corner before a capital programme designed by the Government as a vehicle of inflation can be brought to bear.

VI. *Deadlock in the Money Market.*

Nevertheless an exceptional situation does occasionally arise in which depression becomes so severe that a relaxation of credit fails to stimulate borrowers, and the credit system is at a deadlock. Faced with a decline of demand that seems relentless and illimitable, traders anticipate a loss on any goods they may put their money into. No rate of interest, however low, will tempt them to borrow when they expect a loss rather than a profit on any use they may make of the money borrowed.

There are, I think, many among the advocates of Government expenditure as a remedy for depression who would recognise that it is superfluous so long as the required expansion can be induced by the ordinary methods of credit regulation, but who would recommend it as a way of escape from such a state of deadlock. They would say that it is not enough to increase the supply of money, but that something must be done to *set the money in motion*.

Mr. Keynes does not recommend Government expenditure as the invariable or even the usual treatment for a depression. His first remedy for the "obstinate persistence of a slump" would be open market purchases of securities by the central bank. Those purchases he would regard not as a device for creating money, but as one for raising the prices of securities and stimulating "investment" by lowering the long-term rate of interest.

But that may fail to evoke revival. "When prices are falling, profits low, the future uncertain and financial sentiment depressed and alarmed, the natural rate of interest may fall, for a period, almost to nothing. But it is precisely at such a time as this that lenders are most exigent and least inclined to embark their resources on long-term unless it be on the most unexceptionable security; so that the bond-rate, far from falling towards nothing, may be expected . . . to be higher than usual."

As Mr. Keynes is sceptical of the response of commercial borrowers to credit regulation under any conditions, he describes the state of deadlock in this passage entirely in terms of the long-term investment market. Nevertheless the phenomenon he has in mind is substantially that to which I have referred above.

VII. *Idle Balances.*

Mr. Keynes may reasonably claim that the conditions that he described in the passage quoted are in existence at the present time. At a time when industrialists, faced with dwindling profits, can only afford to borrow at very low rates, investors are so distrustful that they demand a high yield from any but gilt-edged securities. If the existence of a gap between the rate of interest asked and the rate offered results in a part of the savings of the community being uninvested, we may infer that there will be an accumulation of idle balances in the hands of potential investors, and that these balances can be drawn on by a sufficiently attractive offer of new issues of securities.

Personally I feel some scepticism about this situation having arisen or being apt to arise at all at a time of depression. Not that I should deny either the very great decline in openings for capital outlay in industry, or the existence of idle balances. But the decline in openings for capital outlay is accompanied by a decline in the volume of savings, and the latter decline may well equal or exceed the former. To avoid possible confusion, I must explain that I do not use "savings" in the special sense assigned to it by Mr. Keynes. According to his analysis there is a big *excess* of savings at a time of depression, but that excess is identified through his definitions with the traders' *losses*. I use savings in the ordinary sense of unconsumed income, and as a very great part of savings comes from profits, the losses are felt in a *deficiency* of savings.

The existence of big idle balances does not necessarily mean that there is money awaiting investment. At a time of depression there is a tendency for traders who find their transactions falling off to hold working capital in the form of money on deposit. A trader who is liquidating a part of his stock-in-trade will in the first instance apply the proceeds of sale to the repayment of bank advances. But some traders have sufficient capital of their own to cover their maximum needs of working capital and avoid resorting to bank advances at all, and others find that they can conveniently reduce their working capital substantially below the level at which all their bank advances have been paid off. In either case the idle working capital appears as idle cash balances. These balances are not composed of savings which cannot find satisfactory openings for invest-

ment. They are composed of the proceeds of sale of goods by traders who prefer for the time being not to replace the goods sold by fresh purchases.

But of course it is *possible* that there may be deposits that really are awaiting investment. Indeed even those which arise out of idle working capital may sometimes be put in marketable securities notwithstanding the risk of capital loss on realisation. In so far as loans issued by the Government for a programme of capital outlay are subscribed out of these idle deposits, they may exceed the current supply of savings without involving any increase in the bank advances to the investment market.

But that means no more than that the expansive effect of the Government borrowing is not nullified by the investment market. For if, in the absence of any resources derived from idle deposits, the addition of the Government loans raised the total of new flotations above the current supply of savings, the indebtedness of the investment market would be increased, and the market would become less willing to take further new issues. If the programme of capital outlay is to exercise any reviving effect, it is essential, as we saw, that it be financed in the first instance by a fresh supply of money. The mobilisation of idle balances fulfils this condition, but the subscription of the Government's loans direct by the banks would be equally efficacious.

The former course is often regarded as preferable on the ground that the latter is inflationary. But in reality the mobilisation of idle balances is just as inflationary as the creation of credit. Indeed in practice it is quite likely to be more so. If the banks buy the new Government issues, that increases their deposits and reduces their cash ratios, and it may make them less willing to lend in other directions, unless the central bank takes special measures to increase the supply of cash. The transfer of idle deposits to the Government by way of subscriptions to the loans leaves their deposits and cash ratios unchanged.

The technical details are not very important so long as the Government finances its programme by inflation, whether open or disguised. If we ask what is the special virtue of a Government capital programme in the conditions assumed, I think that the answer must be that it is intended to reinforce the inflationary measures by setting the newly created money in motion.

Cheap money fails to induce traders to borrow. The market is overflowing with money, but no one wants to use it. If the Government pays away newly created or newly mobilised money in the form of incomes to the people it employs, the money will reappear forthwith as demand. Increased sales will induce increased pro-

ductive activity, and therefrom will spring a further increase of incomes and of demand and so revival will be started.

VIII. *Further Analysis of the Credit Deadlock.*

This argument depends on two assumptions, first that the inoperativeness of the normal methods of credit relaxation is absolute, and secondly that the capital outlay of the Government will suffice not merely to mitigate the depression but actually to overcome the deadlock.

I think the former assumption is often too readily made. It is easy to point to *certain classes* of borrowing which no measures of credit relaxation could be expected to stimulate. Under-employed industries will not extend their capacity on any terms. And traders who are convinced that the demand for their products is shrinking and prices are falling will refuse to buy more than is needed to keep up the minimum stocks essential for carrying on their business.

But a market in which *everyone* is expecting a fall of prices is an absurdity. The anticipated fall would immediately be transformed into an actual fall, for there would be no buyers.

Suppose, in the first instance, a decline in the consumers' demand for a certain product. Sales fall off, and the traders dealing in the product order less from the producers. If, in consequence of the flagging demand, some of the traders anticipate a fall of price, these traders will reduce the orders they give *below* the amount of their current sales. But the producers, finding orders dwindling, will then cut their prices. It may be that the producers, unable to reduce their costs, cannot bring prices down low enough to suit the dealers. But that can only be a temporary position, for the cost of production is one of the factors that the dealers must take into consideration in estimating future price.

If the dealers think that the producers can and will reduce costs further, they can put pressure on the producers to do so by holding back orders, but eventually they are driven to give orders to the amount of current sales in order to keep up their stocks to the essential minimum. Thus it is only intermittently that an anticipated fall of price becomes a predominant factor in a market. It occurs when there is a difference of opinion between the dealers in a product and the producers, and such a difference of opinion comes to an end either through the producers reducing prices in conformity with the dealers' expectations, or through the dealers being compelled to resume purchases from the producers.

Different products do not pass through the same phase at the same time. A measure of deflation affecting the entire credit system will cause a simultaneous decline of orders in many and perhaps in

nearly all industries, but the subsequent adjustments in different industries will depend on a variety of factors affecting each individually. The pessimism which makes traders in any one industry reluctant to buy, and therefore unwilling to borrow, alternates with more normal conditions in which dealers are replenishing their stocks to the extent necessary to keep pace with sales. Sales are on a reduced scale, but at those periods when the market is not disturbed by speculative anticipations of a further shrinkage of demand or of a further fall of prices, the operations of the dealers on this reduced scale become normally sensitive to credit conditions.

The obstacle to credit expansion is not a state of uniform pessimism prevailing continuously in all industries. It is a succession of impulses of pessimism sufficiently severe and affecting a sufficient range of industries at any one time to offset the tendency to recovery arising in the other industries which remain amenable to credit relaxation. The problem is not one of awakening a response in an economic system which is altogether dead to enterprise, but of *reinforcing* a tendency to revival which always exists in a part at any rate of the system, but which is not by itself powerful enough to prevail. Even cheap money unaided by any other measures might reasonably be expected to start revival eventually, whenever the pessimistic phases happened to be somewhat less pronounced than usual. To wait for such a conjuncture might mean an indefinite delay, but it is not to be inferred that that exhausts the possibilities of credit relaxation.

Mr. Keynes advocates the purchase of securities by the central bank in the open market, primarily for the purpose of reducing the long-term rate of interest. But, he adds, "if the Central Bank supplies the member banks with more funds than they can lend at short-term, in the first place the short-term rate of interest will decline towards zero, and in the second place the member banks will soon begin . . . to second the efforts of the Central Bank by themselves buying securities." With his assumption that commercial borrowing is impervious to stimulation, the efforts of the banks to lend at short-term would be completely abortive, except in so far as additional borrowing by the investment market was brought about. But if we take the view that commercial borrowing can be stimulated, it will, I think, be clear that the purchase of securities by the central bank is likely to be a very effective instrument of credit expansion. The immediate effect is to increase the idle reserves of the competitive banks, and, if they are to preserve their usual proportions, they must extend their assets. We are assuming conditions in which it is difficult to induce traders to borrow, and, if the banks cannot extend their advances, they may, as Mr. Keynes

suggests, buy securities. But to a great extent their purchases of securities will result merely in the investment market paying off advances, so that the desired increase in the banks' assets is offset. If the banks persist in buying securities beyond the point at which the indebtedness of the investment market has been reduced to a minimum, the result will be a disproportionate rise in the prices of gilt-edged securities. There will thus be very great pressure upon the banks to find additional borrowers, and, in view of what I have said above as to the intermittent and partial character of the pessimism which seems to dominate markets, I should contend that there is good reason to expect that the borrowers would be forthcoming. It may be, no doubt, that the banks charge conventional rates for advances, so that cheap money, which applies to bills, does not extend to them. But if the banks are sufficiently desirous of stimulating borrowers, these rates become susceptible of modification, and in any case the intending borrower is very much influenced by the *willingness* of the banker as well as by the actual rate charged. The higher the conventional rate, the greater the desire of the banker to lend, for the business is made thereby artificially profitable to him.

I do not think the degree of success attained by the open market policy of the Federal Reserve Banks in the summer of 1932 has been sufficiently appreciated. The policy was applied under serious disadvantages. The Bank of France was liquidating its dollar holdings and withdrawing them in gold and the United States lost over \$500 millions of gold between February and June. Hoarding also was a complication. Yet the index of manufacturing production rose from 57 in June to 66 in December and was still at 63 in January 1933, and the index of factory employment rose from 58.3 in July to 61.2 in November.

The improvement, it is true, was not sustained. But nor was the policy. The open market purchases ceased in August 1932, and in January 1933 there were even some sales.

IX. *Government Expenditure in relation to the Deadlock.*

I turn next to the question of the efficacy of Government expenditure as a means of escape from the deadlock. In the first place there is the consideration of *time*, to which I have already referred. A capital programme of the kind advocated cannot be started till after a considerable preparatory interval. Secondly there is the question of magnitude. There is no *certainly* that, even when it is started, the programme will achieve its object. For it will have to meet precisely the same obstacles as any alternative method of credit expansion. A programme of £100,000,000 a year

sounds impressive, but it is only about 3 per cent. of the national income. A *sudden* increase of 3 per cent. might quite possibly effect the vital transition, and restore the normal flow of credit. A *gradual* increase of that amount spread over many months would be very unlikely to do so.

The programme might be very much greater. But then there arises a very real difficulty in finding works ripe for execution which are really beneficial. There is a danger of vast sums of money being wasted.

In fact, if what is wanted is a momentary impulse to restart economic activity, it would be more hopeful to look for it in a reduction of taxation than in a programme of expenditure. Suppose a one-clause Act to be passed at a day's notice suspending all taxes (except a few, like stamps and death duties, for which temporary suspension would be inappropriate), and suppose the resulting deficit to be made good entirely by the creation of bank credit. This plan would fulfil the essential requirement that the bank credit created would start on its way as additional income. Some of the additional income would be saved, and would go to increase the resources of the investment market, and this would not assist revival till new flotations appeared. But a great part would immediately appear in the form of additional demand for consumable goods.

As soon as activity was effectively restored, taxation would be re-imposed. But as I have already shown that would not reverse the inflationary tendency already started; it would merely prevent further inflation.

Such a proposal sounds very improvident. It would add a considerable sum to the national debt with no assets to show for it. But the unproductive burden thus placed upon the public might easily be less than that arising from a capital programme of the requisite magnitude.

In fact I should anticipate that a suspension of taxation would meet with more criticism on account of its inflationary character than on account of the additional debt to be incurred. But this criticism would be entirely misconceived.

X. Revival and Currency Depreciation.

To condemn any measure which aims at a revival of business on the ground that it will cause inflation is a palpable absurdity. The very purpose aimed at is an enlargement of the consumers' income and outlay, and that is all that the so-called dangers of inflation amount to.

But this question of a fear of inflation brings me to another aspect of my subject. An enlargement of the consumers' income

and outlay involves increased purchases from abroad and therefore an unfavourable balance of payments. In the case of a country on the gold standard the unfavourable balance has to be corrected by a restriction of credit, which simply reverses the enlargement of the consumers' income and outlay, and undoes whatever tendency to revival there may have been. In the case of a country with an inconvertible paper currency the unfavourable balance can be corrected by an unfavourable rate of exchange. The progress of revival will then be maintained at the cost of a depreciation of the currency.

In fact, unless there is a rise in the price level in terms of gold, depressing the purchasing power of those currencies which remain linked to gold, depreciation of the currency is an indispensable condition of revival. The national income of this country is probably about £3,500 millions, and, if industry is to be remunerative and fully employed consistently with existing rates of wages, it ought to be something like £5,000 millions. If it rose to that figure, the pound would have to suffer a corresponding depreciation; it would have to fall to \$2.50 or thereabouts.

It is no use making plans for bringing about revival unless we are prepared to face this consequence. If the depreciation is to be prevented, then any measures for revival, however promising, will be nullified.

XI. *The Balance of Payments.*

But this is subject to one very important qualification. A programme of public works may itself modify the balance of payments. Once again suppose a consumers' income of 100 millions of currency units a month, made up of 10 millions spent through taxation on the services of Government, and of 90 millions spent on marketable products. Let the Government's expenditure be increased from 10 millions to 11 millions, and let the expenditure on marketable products remain undiminished at 90 millions. Then if (as we may suppose) the additional million spent by the Government is so planned as not to include any importable or exportable products, the balance of payments will remain as before. If we call those products which are importable or exportable "foreign trade products," and all others "home trade products," we may say that the Government through its programme of public works can increase the outlay on home trade products without increasing the outlay on foreign trade products. And, as it is upon the outlay on foreign trade products that the balance of payments depends, the consumers' income can be enlarged without causing an unfavourable balance.

To a country on the gold standard this is a result of some significance. The gold standard precludes a depreciation of the currency,

but the programme of capital outlay gives additional employment without any adverse effect on the foreign exchange position. This is so, by whatever method the programme may be financed, whether by taxation or by borrowing. But if the method is in any degree inflationary, the inflationary effect must be strictly limited; it must not go beyond the point at which the consumers' income is increased by the amount of the programme. If it threatens to do so, recourse must be had to deflation.

It follows that the additional employment anticipated from "repercussions," that is to say that required to satisfy the additional demand of those employed on the capital programme for marketable products, must be ruled out. The additional demand for marketable products would mean the attraction of additional imports, and would cause an adverse exchange.

To say that additional imports can be excluded by tariffs, quotas and exchange control is not to the point. The limitation of imports is *another* device for maintaining parity without resorting to deflation. Provided the limitation is made effective and is applied to invisible as well as to visible imports, there is no theoretical limit to the disparity that may be thereby established between the external and the internal values of a currency unit. It is possible to have both a limitation of imports and a programme of capital outlay concurrently, but we must not attribute to one consequences which are really due to the other.

I have said that the favourable effect of a capital programme upon the balance of payments is the same however it is financed. But here again a certain qualification is necessary. If the money is raised by taxation, the resulting restriction of the taxpayers' expenditure on marketable products may be assumed to be divided in normal proportions between home trade products and foreign trade products. But if the money is raised by loan, there is a presumption (at any rate in a capital-exporting country) that a great part, or even practically the whole, will be diverted from external investment. External investment is in the nature of a *surplus* remaining after the need for investment at home has been satisfied.

If we suppose in our previous example that out of the 90,000,000 currency units spent on marketable products, 2,000,000 are spent on external investment, and half the remaining 88,000,000 is spent on foreign trade products, then we may suppose that, when the Government borrows a million for its programme, external investment is reduced thereby to a million. The additional million of incomes may be supposed to be spent as to half on foreign trade products and as to half on home trade products. The result will be that external investment will be reduced by a million, and imports

will be increased by half-a-million, and there will be a favourable balance of payments of half-a-million, permitting of a further enlargement of the consumers' income.

It should be borne in mind, however, that this further favourable effect is secured at the expense of other countries. It has been freely asserted that the curtailment of external investment by the creditor countries has aggravated the present depression. Experts are even to be found who see in the interruption of normal capital movements and in measures for the limitation of imports the principal causes of the crisis.

That view is, I should say, quite untenable. Nevertheless there are very serious drawbacks to any plan for mitigating the depression, which diverts economic activity in a marked manner from its normal channels.

XII. *International Adjustments.*

When depression reigns, every country has to contract the purchasing power of its population in world markets. In 1929 the national income of the United States was about \$90,000 millions. At the present moment it is little, if at all, above \$40,000 millions. The purchasing power of Americans in world markets has fallen in this proportion. Indeed it has fallen in even greater proportion, for the tariff was raised in 1930, and there has been something like a complete stoppage of external investment.

All other countries have been faced with the problem of making a corresponding reduction in their own purchasing power. In the early stages they effected this by suffering the same kind of impoverishment and unemployment as the Americans. But in 1931 that method became unendurable in a number of countries. Some, like Great Britain, suspended the gold standard. Others resorted to a limitation of imports.

The suspension of the gold standard gives relief through the depreciation of the currency. The country is enabled to reduce its international purchasing power to the required extent without making a proportional reduction in the consumers' income reckoned in its own currency units. It is often supposed that currency depreciation only stimulates the export trades, but that is a mistake. It equally assists those industries which compete with imports, and, since the internal price level adapts itself to the external, it stimulates the whole range of economic activity. In fact the enlargement of the consumers' income is bound to have that effect. Costs in terms of gold being reduced, exports are increased and imports diminished, and the consumers' income must then expand to a sufficient extent to restore the balance of payments to equilibrium by attracting additional imports.

Whereas the depreciation of the currency revives all branches of economic activity impartially, the limitation of imports introduces certain disparities. It gives a special stimulus to the industries that compete with imports and leaves the export industries to their fate. And if many countries resort to it, the effect is felt by other countries in a specially severe decline in their export trade. So serious is this interference with international trade at the present time that it is sometimes argued that the depreciation of the currency cannot re-establish activity in one country so long as these glaring departures from the normal course of trade continue. But however great the disturbance of trade may be, a departure from monetary equilibrium cannot fail to make the situation worse. There is always a *best* monetary policy, that which will, as nearly as may be, make industry remunerative and fully employed.

If now we return to the question of a programme of capital outlay, we find that it resembles the limitation of imports rather than the depreciation of the currency, in that it introduces a departure from the normal relativities of economic activity. It leaves the export industries to bear the full burden of their troubles, and it gives prosperity to the constructive industries which it employs. Since it is the export industries that suffer most severely from the limitation of imports in other countries, a proposal which leaves them out is seriously defective. It cannot rank as anything better than a palliative.

So long as the capital programme is on a moderate scale, the disparities it introduces into the economic system are not in themselves harmful. Depression affects the constructive and instrumental industries more severely than those which produce consumption goods, and measures specially directed to helping them are beneficial. But if the capital programme were expanded to such dimensions as to make a real impression on unemployment, running to a yearly total of hundreds of millions, the artificial diversion of productive activity would become a grave problem.

Currency depreciation is far the most satisfactory measure of revival. Not only is it better balanced, but it is quicker and easier to bring about. I have already pointed out that a capital programme regarded as a measure for breaking the vicious circle of depression is likely to be too slow and too gradual to be successful, and I have suggested that, when cheap money fails to bring about a prompt revival, there is more to be hoped from an open market policy, the purchase of securities by the central bank. I should be inclined to leave the question at that, confident that a sufficient purchase of securities would overcome any depression however severe. For whereas cheap money reaches a limit when the rate of interest

approaches zero, the purchases of securities can be increased indefinitely.

But the depreciation of the currency supplies yet another means of breaking the vicious circle. It is possible at a stroke to reduce the value of the currency in terms of gold to the extent necessary to secure monetary equilibrium. As our experience in the weeks following the suspension of the gold standard in 1931 demonstrated, a sudden depreciation of the currency unit of an order of magnitude of 20 per cent. is quite sufficient to revive the spirit of enterprise, to start the machinery of credit moving, and in fact to break the vicious circle. Here is a short cut to revival, which makes other and more doubtful expedients unnecessary. The world price level can be made remunerative to our producers, and normal activity will become possible.

Nor is this, as is so often said, a merely competitive advantage which would cease as fast as other countries did the same thing. If the world price level became remunerative to the producers of all countries, all would be fully employed. Could a sufficient rise in the world price level be attained by inflation in all countries simultaneously, it would be the ideal solution. Failing that, any country which has detached itself from the gold standard has its fate in its own hands.

XIII. Conclusion.

It will be understood that the course of my argument is by no means such as to allow no efficacy at all to a programme of capital outlay as a measure for relieving trade depression. But the advantages offered by it are very limited indeed.

In the first place we have the capital programme as a vehicle of inflation. In any trade depression which falls short of a complete credit deadlock, such a vehicle is quite superfluous. And even in the case of a deadlock, the capital programme has the grave disadvantage of coming into operation tardily and gradually. Nor is it possible to say how great a programme is needed to resolve the deadlock or whether any practicable programme will be great enough. If a capital programme were the *only* means of resolving the deadlock, we should have to make the best of it, but I believe that there are good reasons for supposing that a sufficiently liberal measure of open market purchases by the central bank would be bound to achieve this object.

Then secondly there is the effect of a capital programme on the balance of payments to be taken into account. A country on the gold standard, faced with the prospect of an appreciation of gold and unable to promote the international cooperation requisite to

stop it, may be grateful for anything which will relieve the depression without causing an adverse balance of payments. But under those conditions the capital programme can be no more than a palliative; it does not promise to be a turning point in the depression to be followed by a progressive revival, for revival depends on international conditions. And to a country which has abandoned the gold standard, the favourable balance of payments induced by a capital programme is no advantage at all; it merely raises the value of the currency unit, and thereby discriminates against the producers of foreign trade products.

Since a programme of capital outlay offers so limited and doubtful a contribution towards revival, I think it is regrettable that excessive prominence is given to it by economists. Economists are often blamed for offering discordant advice at a time of crisis, when there is so urgent a need of a clearly defined economic policy. There is without doubt a fundamental difference between those who look forward to continued deflation and seek equilibrium in bigger and better bankruptcies combined with drastic cuts in wages, and those who recommend inflation with a view to bringing prices into equilibrium with wages and restoring general solvency. But there is no need to make a division in the camp of the inflationists. If they agree as to the end, that is a great gain, even if they differ as to the means.

When the practical financier pronounces the money market to be completely dead to the credit stimulus, economists have been too ready to abandon hope from the ordinary methods of credit relaxation and too ready to adopt the superficially plausible view that Government expenditure will be inflationary. Has not the prejudice against inflation contributed to the prevalence of this attitude? In the eyes of the practical financier the real objection to open market purchases by the central bank on the grand scale is not that they will fail to induce inflation but that they will succeed. But he can be got to assent to a capital programme because he can be persuaded that it will give employment while he does not associate it with inflation.

But an attempt thus to outflank the prejudice against inflation is doomed to failure. If a capital programme is to offer any prospect of revival it must be avowedly inflationary. It must be associated not only with a creation of credit, but with a depreciation of the pound. To initiate the programme with the tacit assumption that inflation is to be prevented, would be the extreme of futility.

DISCUSSION ON MR. HAWTREY'S PAPER

SIR BASIL BLACKETT: It is a privilege to be invited by the Royal Statistical Society to move a vote of thanks on any occasion, and I am particularly gratified to have the opportunity offered to me on this occasion, as the reader of the paper is my old friend and colleague Mr. Hawtrey. Mr. Hawtrey's analysis of any subject is always stimulating; he manages to display many more facets of a subject, whatever it be, than the ordinary human being is aware of until he has heard Mr. Hawtrey. I am sure that we have all benefited greatly by reading Mr. Hawtrey's paper, and still more perhaps by hearing his delightfully humorous résumé of it. It is many years now since I first told Mr. Hawtrey that in the course of long years of discussion with him, I had never found myself able to disagree both with his premises and with his conclusion. The present is another such occasion. I am inclined on the whole to accept the greater part of his conclusions, but I am doubtful about some of his premises, and I am afraid I do not quite understand all of them.

I should like to put the case in a simplified form which I believe to be a true presentation of Mr. Hawtrey's views, with a great deal left out, but if it is not, I can only apologize and ask him to correct me later.

Mr. Hawtrey begins by stating the old Treasury view, as it used to be called, that Government expenditure on capital works, whether financed by loans or by taxation, cannot add to the total amount of employment in the country, because it must be financed out of income, and it is simply a diversion of employment from one kind to another; that—when a country is on the gold standard—I believe to be essentially true. Government can direct expenditure to certain channels and away from others, but when it is attempting to do so out of income, it cannot add to the total volume of employment in the country except in so far as it can anticipate a certain part of employment. Mr. Hawtrey moves on from that to say that when a country is off the gold standard, as England is at present, the same is essentially true provided that it is assumed that the Government capital expenditure will be met out of income and not by inflationary methods. If it is met out of income the position is exactly the same as if the country were on the gold standard. Mr. Hawtrey goes on from that to say that Government expenditure can only add to the total volume of employment in the country (using the word "volume of employment" in the same sense as he has used "consumers' income") if the Government expenditure is financed by inflationary methods. But in those circumstances he says it is quite unnecessary for the Government to embark on a programme of capital expenditure; all that is necessary is that the Central Bank shall provide for this increase by open-market policy. Unless indeed, he says, the normal methods of credit relaxation are absolutely inoperative; but he defines such a condition of affairs as being incredible, so that we need not take too much notice of that particular qualification.

His conclusion therefore is that all that is necessary is that the Government should recognize that the way to increase employment is to go in for an inflationary policy worked through the Central Bank, and that that alone will in present circumstances be enough.

I followed him up to there, but at the last point I am inclined to disagree with him. When he suggests an open-market policy leading to large purchases of Government securities by the Central Bank, he does not, I think, provide any means of putting that money into motion other than the means that already exist. If the easy money that exists at present does not lead to enterprise and new employment, then why should any additional amount that may be created for the purpose of causing inflation have the effect of increasing enterprise? No doubt if you magnified the sum sufficiently, you might reach a state of affairs where new considerations come into play, but I do not think he has that sort of supposition in mind. I do not think that last conclusion, that central market operations would be enough, is one that can altogether be substantiated. I suggest that something is added by a Government programme of expenditure. When a Central Bank goes in for open-market purchases of Government securities, it must buy those securities from existing holders. If a Government goes in for a programme of expenditure, it is able to sell, not existing securities, but new Government securities, to the Central Bank, and the Central Bank's open-market purchases take the form of newly created Government securities. The Government thereby, I think, does get control of new money which it immediately puts into motion, which does not apply if the Central Bank merely purchases existing securities from existing holders.

I am inclined to agree with Mr. Hawtrey that a Government programme of capital expenditure is in any case a very slow method of arriving at the required result. Quite apart from any question which tends to divide political parties as to whether Government programmes of capital expenditure are desirable or not, there must inevitably be very long delay in making an effective addition to the amount of works in hand, if the Government has first of all wisely to choose its programme and then gradually to put it into force.

I have the disadvantage of speaking at a moment when the Budget Speech has already been delivered and I do not know what it contains, but I believe Mr. Hawtrey would agree with me that a much quicker way of doing the same thing would be for the Government not to go in for a programme of capital expenditure, but to reduce taxation and finance its deficit by selling its securities to a Central Bank. That seems to me to be likely to be much more quick in its operation than a capital expenditure programme, because not only is the additional money put into motion immediately, but the taxpayer is then in the happy position of being relieved of a portion of his liability to the Government in the form of taxation. That is why I believe a reduction of taxation, involving a deficit met by inflationary methods, is the quickest way of securing the objects which we have in mind. I do not believe

that a mere open-market policy by the Central Bank is sufficient in present circumstances to cause the money to get into motion, but I believe that if combined with this reduction in taxation, there would be better hope of securing the result and it would be spread over a wider circle.

Mr. Hawtrey says you must recognize the necessity of a fall in the value of currency. I think it is true that you ought to be prepared to face a considerable fall in the value of sterling in the terms of other currencies if you embark on a policy of this sort. I am not sure that the new demands created would not spread so quickly that you might have new conditions arising in which gold prices and sterling prices rose, and the exchange value of sterling might not necessarily fall. Whether it did or not, I agree that it is quite necessary to be prepared to envisage this.

At the present moment, with what is going on in America, it is surely desirable that we should prevent sterling rising in terms of the dollar to such an extent that it will get none of the advantages of the rise in dollar prices going on in America. I think there is liable to be a good deal of misunderstanding and mistaken view on this matter. For example, the Bank of England has acquired something like sixty-six millions of gold in the course of the year 1933. It is often said that this gold represents bad money—money that has fled from other countries to take refuge in sterling. I believe that to be an exaggerated statement. Only a small part of that gold represents money on short or long term that has come to this country from foreign countries. It represents to a large extent a redistribution of the gold resources of the British Empire. Quite a large sum has come from Australia, which is deliberately ridding itself of gold, and large sums have come from India. There has been for some time now a large and increasing balance of trade in favour of the sterling area, and that favourable balance of trade takes the form of an increase in gold in this country or a rise in sterling in terms of gold currencies. If the policy has been to prevent, until recently, a rise of sterling in terms of gold currencies, surely the authorities ought to welcome some opportunity that would give them a means of preventing that rise other than this enormous accumulation of gold. The danger we are faced with is, I believe, a very serious one. Mr. Roosevelt in America has, in my opinion, quite rightly decided that the time has come to take new advisers and do something to raise dollar prices even at the expense of going off the gold standard. I am rather afraid of what may be going on at the present moment in Washington with regard to the suggestions of the immediate stabilisation of the pound and dollar in terms of gold, for I do not believe the moment has come at which we can decide at what ratio to gold either the pound or the dollar ought to stand in the present circumstances, and I think it is regrettable that the newspapers should talk about monetary stabilisation as being the absolutely essential pre-requisite for the recovery of the world. By monetary stabilisation they mean simply stabilisation of currencies in relation to gold and each other, and not the far more important thing, the stabilisation of internal

price levels. If stabilisation were thought of in relation to price levels, I believe the prospects for the immediate future and for a long period of time would be much more satisfactory than if we once again find ourselves tied to a gold standard, unless there is a Central Bank of the world wise enough and strong enough to manage gold so that gold becomes merely a figurehead and not the arbiter of our destinies.

I have strayed rather off the track of Mr. Hawtrey's paper, but I must now once more come back to it and move, with very great pleasure, a cordial vote of thanks to him for the excellent paper read before us to-day.

MR. HARTLEY WITHERS: I must apologize to you and to Mr. Hawtrey for having been put into this position, which is as awkward for me as it will be disastrous to you. It is not my fault; I was told by the Secretary that all the people on whom he had been relying to discuss this matter had let him down, and that I must get up and make some sort of noise. I feel I have no right whatever to speak in the presence of this learned and scientific Society, because I am not a statistical scientist; in fact I am a mere popularizer, and I need not say that to the scientist a popularizer is as disgusting an object as the historical novelist is to the historian. But I spend most of my life in trying to interpret the works of the economists, in so far as I can understand them, to the man in the street. On this occasion I will try to put before you, economists and scientists, the views of the man in the street as I find him and talk to him in the City, and I want to suggest that this is rather an important point of view in dealing with this question—whether it is a good thing to have public expenditure in order to cure and check trade depression. This depends almost entirely upon the psychological effect it is likely to have upon the mind of the business man. If that is too crude and popular an impression to put before you, I can only apologize, because it is the only thing about which I can talk to you. I find people in the City all saying "What on earth is to be done to get this miserably jammed machine working again?" and that is the question which is exercising them most. They see that there is any amount of money in the country—more, I think I am right in saying, than there has ever been before—and any amount of materials going about at unremunerative prices and any number of people wanting to work, as well as things needing to be done, and they want to know why something cannot be done to take advantage of these conditions to get the thing going again. I want to suggest that since this crisis is almost entirely psychological, and this deadlock of depression has been produced chiefly by Governmental action and Governmental mistakes here and in other countries, it is fair on the part of the business man to ask the Governments to do something to give the thing a shove and start the machine working again. When one is told—if I understand Mr. Hawtrey aright—that if the Government were to issue securities in order to borrow and spend the money and start things again, that those securities would be subscribed for out of income,

I venture to think that it is not stating the position quite correctly. According to what I hear in the City, there is a large amount of money lying idle because people do not want to spend it either because they have not confidence in the profitability of industry, or more probably because they do not know what their income is going to be next year, and consequently they are holding on to their money. The ordinary machine of private enterprise being jammed, it is surely worth considering whether public expenditure is not a reasonable way of trying to get it to work again. I am not suggesting that we should have a two hundred million Government loan or any such grandiose scheme as we have heard of in certain quarters in years past; but the business man's view is that this Government, having been put in to cure an era of gross extravagance for which all parties have been responsible, has now gone much too far in the other direction, and has been shutting down all kinds of public works by public authorities. There is surely a *via media*, by means of which something might be done—not necessarily by the issue of Government securities, but by inducing Departments not to oppose this “damned disinheriting countenance” to every scheme of expenditure by public authorities, but to let things go ahead and, if necessary, occasionally give a guarantee. We know that under present conditions a great many things need to be done, and we see that there are the means, money, and men to do them; why should not the Government do something just to give a push? As to whether it should be done out of taxation or out of borrowing, I could not quite follow Mr. Hawtrey's extremely interesting and attractive argument, by which, so far as I could understand, he proved that if you tax you produce taxable income. It certainly sounds very good if that is true, and I hope it is, but he rather spoiled it by saying there was a long time lag and “certain conditions,” and so forth.

Believing, as I do, that this thing is almost entirely a psychological problem, I think the less taxation you have in the matter the better, and that things could be helped far more materially and quickly if it were known that the Government were in favour of encouraging constructional efforts by encouraging public works, if necessary with an occasional guarantee, and if it were known that the Government were not afraid of inflation, if necessary, to carry this out.

Inflation, so far as I understand the word, simply means a rise in prices due to an increase in the volume of money. Since a rise in prices has been constantly advocated by the Macmillan Committee and most people who have spoken on the subject since, if inflation will produce that rise in prices, it is surely the very thing that we, and the rest of the world, need.

I shall not be able to stay and hear myself used to wipe the floor with by Mr. Hawtrey, because, as I explained to the Secretary, I have to catch a train. I apologize to Mr. Hawtrey and to the Chairman, and I have very great pleasure in seconding this vote of thanks for the very able and interesting paper to which we have listened this afternoon.

MR. G. A. H. SAMUEL said he had been much interested in the paper. The author had defined trade depression primarily as a shortage of demand in terms of money. Would it not have been better stated as a slackening in the velocity of the circulation of money? It would be remembered by those who had read Bagehot that the question of trade depression was a time question. Bagehot stated that time as an element in trade operations made the whole of the difference between periods of great prosperity and periods of great adversity. The present was a period of great adversity, and if the cause of the slackening of the velocity of circulation were enquired into, it would be possible to get at the root of the problem. A main cause of slackening was taxation, local and national. Only recently he heard of a professional man who always kept a large Bank balance, and when asked why he kept so much money at the Bank replied, "Every time I receive a fee I put 25 per cent. into the Bank in order to meet the demands of the Chancellor of the Exchequer, otherwise I might be a dweller in Brixton prison." That man's expenditure was slackened and delayed because of the apprehension of future taxation, and such delays were a primary cause of trade depression.

A number of people said that the real need was a rise in prices; but prices must be raised in the normal fashion. It was no use causing an artificial rise in the barometer in order to bring about fine weather; in the same way fine trade weather could be obtained by not restricting the velocity of the circulation of existing currency. It was useless to increase the currency that already existed. If there were a thousand times the currency which existed at present, and it were treated in the same way that the pound sterling was being treated, there would be no genuine improvement of trade. It was desirable for people to understand that every penny taken in the course of local or national taxation—and local taxation was in many cases worse than national—was a penny forcibly delayed in circulation. He did not mean that it was wasted, but it was delayed, and the delays were causing trouble throughout the whole of the civilized world.

MRS. ROBINSON wished to point out what appeared to be a very profound theoretical difference between Mr. Hawtrey and Mr. Keynes. The point was involved in the question of savings being wasted. Mr. Hawtrey's point was that even if there were idle balances these might not represent savings awaiting investment. Mr. Keynes's point was that even if there were no idle balances there might be savings which were running to waste, because in his system when savings were in excess of investment, losses were being made, and by "losses" she meant cash losses, such as businesses continuing to be run when the receipts were not covering the actual out-of-pocket expenses. The savings might be borrowed to meet the losses through the medium of the banking system or by selling securities out of reserves. There was no need for there to be idle balances; the savings were going into buying the securities. Further, in so far as business men tried to throw off

these losses by cutting down output, they created unemployment, and in so far as the unemployed were able to continue to consume when earning nothing, then savings must be put at their disposal. Therefore excessive savings, instead of being turned into capital goods, were used up in depressing prices by enabling goods to be sold at less than cost of production, and in enabling the unemployed to continue to live.

MR. PETHICK LAWRENCE felt that there were three especial points for discussion in what Mr. Hawtrey and the subsequent speakers had brought forward. The first related to the question of inflation. Hitherto they had been taught to regard inflation as one of those terrible evils to be shunned at all costs, but Mr. Hawtrey himself, Sir Basil Blackett, and Mr. Hartley Withers had blessed inflation and relieved it of the ignominy from which it had hitherto suffered. Mr. Pethick Lawrence felt disposed to agree with that point of view, but would like to add that it was only because of the present depression that inflation was a suitable remedy, and that both inflation and deflation were things to be avoided when once the world had reached a position of economic sanity with a stable price level. It was because there had been a long period of continued deflation that stability of prices on a prosperous basis must be preceded by some measure of inflation.

As to the effect of inflationary action on the sterling exchange, Mr. Pethick Lawrence was inclined to agree with Sir Basil Blackett rather than with Mr. Hawtrey. He believed it to be a fact that since Great Britain went off the gold standard the exchange had fallen a great deal more than the purchasing power parity would account for, and therefore additional activity at home and some actual inflation might take place without necessarily depressing the exchange.

The next point was with regard to the question of Government expenditure on public works and its effect on employment. Mr. Hawtrey took the view that it was almost nugatory, and Sir Basil Blackett that though it was not nugatory it might be rather slow in its operation. Mr. Pethick Lawrence could not help thinking that it was not quite such a lame dog as either of them imagined. He quite agreed with Mr. Hawtrey that if Government borrowing was accompanied by great care to avoid inflation, the effect was to take away with one hand what was given with the other, but provided they were not afraid of inflation, he could not help thinking that Government expenditure was much the best engine for the purpose. When Sir Basil Blackett said it was so slow in operation, he was surely confining himself in his mind to new undertakings not envisaged up to the moment. If for "Government expenditure" one substituted the words "removal of the ban on expenditure which would otherwise take place," and included the expenditure of local authorities, there would be no question of delay; it might be almost instantaneous in its operation.

With reference to taxation, both Mr. Hawtrey and Sir Basil Blackett took the view that the remission of taxation was a more

expeditious method than an extension of public works. Mr. Pethick Lawrence could not agree with that. First of all, on the purely physical ground; there was a considerable delay in the collection of taxation; most of the returns from direct taxation, for instance, did not come in till nine or ten months after they were imposed. Then as to the psychological reaction. If the Government at once declared its intention to carry out a large amount of expenditure, that would operate psychologically on people's minds just as speedily as the remission of taxation. In this matter he agreed with Mr. Hartley Withers that the man in the street looked to extension of enterprise as the one means of re-starting the ball rolling. He was convinced that from whatever point of view the question was regarded the removal of the ban of the Government on public enterprises, and the assurance in the mind of the ordinary man that the "economy stunt" was not a permanent course of action, would be a more desirable method of approach than the remission of taxation.

These views were stated not in any spirit of hostility to Mr. Hawtrey, to whom all were enormously indebted, but because they seemed to be the chief points of interest emerging from the paper.

MR. NORMAN CRUMP expressed his pleasure at being able to support the vote of thanks, though he did so at rather short notice. Like Mr. Hartley Withers, he had been given to understand that there would be several batteries of heavy artillery in attendance, and that his support would not be required.

There were one or two points he would like to put forward, not in criticism, but as one seeking for further information. Mr. Hawtrey and Sir Basil Blackett had both pointed out that the necessary condition of a successful expansionist policy was that the country practising it should not be on the gold standard, as otherwise gold would be lost, and it would be necessary to restrict credit as fast as it was created. He accepted that thesis—provided that a sufficient number of other countries were not doing the same thing. If all countries were engaged in expansion, there was no reason why any country should lose gold.

The next question he would like to ask was one already suggested: was it sufficient for the Central Bank, through its open-market policy, to extend credit? In this connection, he would like to recall that a year ago there was created in this country an Exchange Equalisation Account, and during the last few months that account had accumulated vast quantities of foreign exchange. Without going into detail, any purchase of exchange by the Account tended to inflate bankers' deposits at the Bank of England—that is bank "cash," permitting of a proportion to increase in bank deposits, and in point of fact, there had been an increase in bank deposits to something of the order of two or three hundred millions. Yet there was no evidence that this increase had raised prices or revitalized trade. This suggested that something more was needed beyond a bare creation of fresh credit.

Mr. Hawtrey had put forward a case for creating inflation

directly as opposed to public works, and Mr. Crump would like in this connection to put forward one or two practical considerations. The first point was that, when once a country started on a policy of naked inflation, was Mr. Hawtrey certain that it could be controlled, and could he show how it could be controlled, bearing in mind that inflation, in raising the prices, also raised national expenditure. There was, moreover, an obvious time-lag before the yield of taxation expanded as well, and this was particularly true of direct taxation. Mr. Hawtrey had to convince us that when he had deliberately created a budget deficit he could correct it as soon as it became desirable.

The next point was one which perhaps Mr. Hawtrey would hardly feel able to answer. To put it briefly and bluntly, which was the more practical course of action, bearing in mind the circumstances under which the present House of Commons was returned to power—to persuade them to embark on a policy of naked inflation, remembering Government and other pronouncements in the election of 1931, or to put forward a policy of national expenditure upon public works, which in reality was inflation garbed in a suitable and decent disguise?

The next question referred to a matter that had already been discussed. Did Mr. Hawtrey admit that there was such a thing as idle money and idle capital in the country? If he did, and if there were money awaiting investment, then the case for offering to the owners of that money safe investments in the form of securities for financing public works gained strength, because it boiled down to bringing into use money and credit which already existed.

Finally, how did Mr. Hawtrey's question of inflation and letting the pound go down, bear upon the question of creating activity and employment in the export industries? If home prices were allowed to go up and the pound to go down, it by no means followed that the rise in home prices and the external depreciation of the pound would actually be equivalent to each other. Great uncertainty would in any case arise, and whether exporters would gain or lose on balance was an open question, but, in any case, Mr. Crump could not see how inflation in England could restore the purchasing power of her former export markets; in fact what was wanted was not so much the raising of prices at home in England, as the raising of prices in the primary markets overseas, both inside and outside the Empire.

Mr. Crump apologized for his brief review of the paper; he had not expected to have an opportunity of speaking, and therefore had not studied the paper so carefully or so closely as he would have done had he expected to have had that opportunity. But he was most grateful to Mr. Hawtrey for explaining one of the most intricate and difficult questions before the country at the present time in that clear and simple language that one had learned to associate with him.

PROFESSOR JONES said that before referring to Mr. Hawtrey's paper he would like to say a word about the reference made by Sir

Basil Blackett to the recent suspension of gold payments by the United States. Many were disturbed by the latest views of the newspapers—and newspapers were always right!—to the effect that an early stabilisation of the pound in terms of dollars was to be expected. People living in London and working in the City usually thought and wrote in terms of the dollar, but he ventured to submit that when the United States went off gold, the dollar rate ceased to be the most important rate of exchange. If a return were made to some stable relationship with the dollar, without first having obtained a clear understanding about the future relationship of the dollar to other currencies, the country might find itself in the same position as that which prevailed from 1925 to 1931. He would venture to offer two suggestions to financial journalists present, (1) that they should cease to quote the pound in terms of shillings, and (2) that they should cease to put the dollar rate at the top of the list, and should instead transfer to that proud position the franc rate. The franc rate was the key rate in Europe at the present time.

Like others present, he had thoroughly enjoyed Mr. Hawtrey's paper, the more so as it was at least as provocative as his other contributions. He wished to express his gratitude to Mr. Hawtrey for stressing the limitations of a policy of capital expenditure: he was sorry, however, that Mr. Hawtrey seemed to have linked that policy to Mr. Keynes's analysis. There were many economists in the country who were not under the influence of Mr. Keynes's analysis, or his estimate of the relative elasticities of demand for credit and for long-term capital, but had arrived at the same conclusion on this particular point. The two things were not bound together in the way suggested or implied by Mr. Hawtrey in his paper. Anyone, however, who had read the paper must have agreed with Mr. Hawtrey that it was impossible to cure all the evils in the country by simply increasing Government expenditure, whether on capital or other account, and as one of those who signed *The Times* letter to which Mr. Hawtrey obviously referred, he would like to say that he personally was not among those who thought that a very great deal could be rapidly achieved by a policy of loan expenditure. But what was possible should be done.

In the second place, he was grateful to Mr. Hawtrey for emphasising the fact that the possibility of credit expansion in the ordinary way had not yet been fully tested. There was one factor that was usually ignored in these discussions, when emphasis was placed upon the price of credit and the supply of credit, and that factor was the collateral security asked for by the Banks when offering credit to borrowers.

There was an interesting controversy in the United States two years ago; the Bankers of New York, stuffed with deposits that had come East from the Middle West, said that they were practically on their knees to borrowers. The borrowers, on the other hand, said that they could not obtain as much credit as they wanted from the Banks. The truth of the matter appeared to be that the Banks were anxious to find satisfactory borrowers, and that there were

plenty of borrowers seeking the assistance of the Banks but not regarded as satisfactory. That was very similar to the situation in this country at the present time. The Banks were said to be on their knees to the good firms of the country, but they were more critical of collateral security deposited with them than they had ever been in the past.

During a period of trade prosperity, when a boom was developing, the Banks tended to over-value the security offered them; during a period of depression, such as existed at present, many forms of security submitted to the banks were seriously under-valued and credit was refused to legitimate borrowers on account of this fact. It would be well therefore, for the Banks to show a little more courage and optimism in their valuation of collateral now offered by borrowers.

Professor Jones agreed with Mr. Hawtrey in his statement that whatever policy were pursued, what might be called a holiday for the taxpayer would be more likely to produce immediate and considerable results than the policies put forward by Mr. Pethick Lawrence and other economists. But that statement seemed to conflict with the statement, appearing elsewhere in the paper, to the effect that a Government could increase expenditure during a period of depression, irrespective of the question whether the money was obtained by means of taxation or by means of loans. He ventured to submit that Mr. Hawtrey was quite right in his statement provided the time lag was a proper one. If a start were made by increasing employment through Government expenditure, by the issue of a loan—the type of loan did not matter—in due course the loan would be repaid by means of taxation. If in the meantime the loan policy had had its effect upon industry, and trade and society had reached the stage at which all savings could and did find avenues of investment, then the repayment of the money by means of taxation would not be deflationary because it would go into a fund which would automatically be invested; but if the loan were repaid immediately, then the mere repayment of the money (secured by means of taxation) needed to finance the expenditure, would have precisely the same effect, quantitatively, on the deflationary side as expenditure on the inflationary side.

Later in his paper Mr. Hawtrey seemed to carry the same type of argument still further when he referred to the possibility of increasing employment in the country by depreciating the exchange. He said, in effect, that by going off the gold standard and depreciating the exchange it would be possible to increase employment more quickly and more permanently than in any other way, and then he went on to say that it did not make any difference if a similar policy were pursued by other countries at the same time. In other words, by depreciating the exchange it would be possible to increase exports, decrease imports and thereby secure an all-round improvement in the trade of the country, and then when other countries did the same, they could enjoy the same results. Professor Jones submitted that in those two pieces of analysis, very closely connected from a purely analytical point of view, Mr. Hawtrey had been guilty of the fallacy

of the single instance: that if a thing be good in one case it must necessarily be good in all cases; but the effect in one country would be destroyed by extending it to other countries. If there was a process of external currency depreciation, as distinguished from inflation, going on for the purpose of increasing the prosperity of one country, and then all others joined in the game of competitive depreciation, as some had recently done, the result would be serious. If Mr. Hawtrey was right, there was no danger to this country in the fact that the United States of America had deliberately depreciated her currency by going off gold, but it might result in increasing her exports and decreasing her own imports in precisely the same way as we had been able to re-direct world trade in our favour when we went off gold.

What really was assumed in the argument was not depreciation in the sense of external depreciation, but a rise in prices elsewhere following a substantial rise in this country. The United States had gone off gold now for the reason that if she had inflated her currency and raised the price level before going off gold she would have stimulated her imports and reduced her exports, and the policy would have collapsed. The condition of success in an inflationary policy was that the country should first of all go off the gold standard, so that any subsequent internal inflation would be balanced by a corresponding change in the exchange rate. If a fall in exchange reflected internal inflation it would have no undesirable reaction in other countries.

It seemed to Professor Jones that running through the last portion of the paper there was this confusion of the particular and the general, of external or specific depreciation and inflation or general depreciation. In venturing this criticism, with great diffidence, he would like to indicate his enjoyment of the paper, which was perhaps the greater because he had been able to criticise it.

MR. BARNARD ELLINGER shared the view of Mr. Hartley Withers that the psychological effect on the man-in-the-street could not be left out of account, and it was very largely for that reason that he profoundly disagreed with the suggestion that the desired effect could be achieved by reducing taxation and borrowing in order to make good the deficit. He thought that Mr. Hartley Withers in talking of the man-in-the-street was mainly concerned with the man in Lombard Street, whereas he was himself mainly concerned with the man in Market Street in Blackburn and in Bolton. He would like the psychological effect on unemployed people of any such policy to be considered. The unemployed had been told in 1931 that it was necessary for the dole to be cut to the extent of 1s. 8d. a week—which is equivalent to an income tax of about 20 per cent.—in order that the budget should be balanced, and that if the budget were not balanced the country would be forced off the gold standard, in which case they would lose all their savings. The country went off the gold standard and the unemployed were then told everything would be all right because the budget was balanced. Mr. Ellinger said he did not want to have to go to Lancashire and explain to the

unemployed there that it was all right to take *rs. 8d.* per week from them in order to balance the budget and then safe to go off the gold standard, and that now it was safe to unbalance the budget, not to give them back the *rs. 8d.*, but to take something off the beer of the employed—the unemployed cannot afford beer—and to reduce income tax, so that people would be encouraged to invest their savings and thus provide more employment. Psychologically, such an explanation was impossible.

With regard to the question of stabilisation, he did not think that the country was going to stabilise in a hurry. Speaking as a Lancastrian he was very much afraid, however, that when stabilisation did come, regard would be had to the price level of this country relatively to those of America and the gold standard countries. That would be quite all right for nearly four-fifths of the export trade of the country, which was in competition with those countries. It would be all wrong for the remaining one-fifth of our exports, viz., cotton goods, whose one competitor was Japan. If stabilisation were to take place without regard to the interests of the cotton trade, that would add the last straw to the camel's back. Reduced though they were, the value of the cotton exports, after paying for all the imported raw cotton, still made a contribution towards balancing the nation's trade which was equal to that made by the whole of the profits earned by the "City" on its foreign business.

Concerning the price level Mr. Ellinger said that we had been told continuously that there were two causes for the present depression; first that prices were too low. That could be understood. Financiers all over the world had made large advances to farmers and other people. Since these advances had been made prices had fallen so low that the security had depreciated and the lenders could not balance their books because the borrowers could not repay the advances, and the security, if sold, would not realise the amount advanced on it. That is a serious position because it impedes the restoration of confidence. The position cannot be met by a reduction of interest only, for the capital values still remain at inflated figures. The remedy appears to be either "more and better bankruptcies" or a raising of the general level of prices. Secondly we had been told that the depression was due to the dislocation between the prices of primary products and manufactured goods and it was difficult to see how this could be remedied merely by raising the general level of prices. If the stocks of primary products which existed were only abnormally large in relation to an abnormally small demand, a rise in the general level of prices would stimulate demand for manufactured products and consequently for primary products. The prices of the latter being less rigid would rise more than those of the former and the present dislocation might be adjusted. But that is not the case; the stocks of primary products are abnormally large even for a normal demand. In many commodities there is a year's carry over of stocks and production proceeds apace on a scale sufficient or almost sufficient to meet a normal demand. How are these abnormal stocks to be absorbed? Until they are the maladjustment between the prices of manufactured

goods and those of primary products will continue to exist. Something more than merely raising the general price level is required.

Mr. WYATT sent the following contribution after the meeting :

Mr. Hawtrey considers that the efficacy of capital outlay as a means of relieving trade depression is very limited indeed and advocates open market purchases by the Central Bank. I think he underestimates the amount of credit thus created which would be sterilised by a rise in Stock Exchange prices of fixed interest securities, and I am afraid the amount of credit which would have to be created by the Central Bank would be so great that sufficient opposition would be aroused to stop further creation before the task was half finished, with disastrous results, as evidenced by recent American experience. Surely trade depression is "lack of spending." Somebody must spend. If individuals are afraid or unable to spend Governments and municipalities must do so if trade is to be maintained. Why not use this method as well as Central Bank operations? Certainly the amount required to be spent would be large but it would only be spending money otherwise hoarded and it would still be here after it is spent. The cheap money policy would also assist in keeping down the cost of the necessary borrowing of the hoarded money.

I am sorry Mr. Hawtrey was apparently frightened by the Balance of Payments bogey; a little investigation in the City would bring out a long and formidable list of money belonging to English nationals held in blocked accounts abroad, which cannot be remitted here as our balance is far too favourable, and if uninformed public opinion must be placated, why not give Government assistance to enable our manufacturers to give long credit to foreign purchasers of our goods? The resulting exports would make our balance look very healthy, besides assisting employment here.

I should also like Mr. Hawtrey to define what he means by "waste of money." Where does it go to when it is wasted? This very valuable paper emphasised to me the need of a thorough statistical investigation into the causes of the depression both here and abroad. Much of the data on which most important decisions have to be made are hopelessly inadequate and obviously incomplete. Cannot the Society use its influence to see that this state of things is remedied? The cost would be infinitesimal compared with the benefits to be derived from it.

MR. HAWTREY in reply, said: I would like to say how extremely interesting and stimulating the discussion seems to me to have been. It would be impossible for me to deal adequately with it in the time at my disposal, and I think I should be wise to take advantage of the opportunity given to supplement my reply in writing in the Journal.

I was glad to find that Sir Basil Blackett expressed a considerable measure of agreement with my point of view, but he was in doubt as to whether the open-market policy could be sufficient to overcome the deadlock in the credit market. His doubt was not without

reservation; he said that if the sum were magnified sufficiently it might accomplish the purpose. I do not think a fantastic sum would be required, and, if the sum is likely to be very large, that is no reason for not trying at all. Certain figures have been quoted as to the creation of credit by the Bank of England, but it is on a modest scale as compared with what the Federal Reserve Banks did last year, and their operations had a very considerable effect on the banking crisis. The index of the manufacturing production rose to 66 and even in February was 62, as compared with 58 in the middle of last summer.

Another point that Sir Basil Blackett did not quite take into account was that I recommended a depreciation of currency expressly as a method of breaking the deadlock. Perhaps I ought to have expounded that point more fully in the paper. We had experience of the effect of sudden depreciation of the currency when we went off gold. The pound fell by 20 per cent., and for one brilliant moment industry became remunerative and the deadlock was completely broken. It was no longer difficult to find borrowers willing to obtain advances from the Banks in order to buy commodities. That was snuffed out by a rising Bank rate, of 6 per cent., which meant that the dominating factor was the unwillingness to lend.

SIR BASIL BLACKETT: What do you mean by depreciating currency?

MR. HAWTREY: We have had an example in the United States. I suggest the simplest way to do it here would be to quote gold at 170/- per fine oz. and to buy francs at a corresponding price, and see what happens. It is the function of the Bank of England and of the Central Bank to create money, and by creating pounds and offering them in the market for gold and gold currencies, it can reduce the gold value of the pound to any desired extent.

Sir Basil Blackett also referred to the advantages of a budget deficit over a capital programme. I put that into my paper not quite as a serious proposal, but rather as a reduction to the absurd. I did not really think it was practical to suspend all taxation at a moment's notice, but when I suggested it I did not mean to confine it to income tax; I had in mind free tobacco, free beer, tea, spirits, entertainments; if all that money were put into the pockets of the people it would have some effect.

Mr. Hartley Withers laid great emphasis on the existence of idle money. I had a good deal to say about idle money and the conclusion come to in my paper was that it did not make much difference whether credit were created or idle money started to move.

One subsequent speaker suggested the advantages of offering securities on attractive terms in order to start these balances moving. But cannot securities be bought on attractive terms now? It might be said that if the Government really started in deadly earnest, War Loan would be quoted at about 80 and people would rush to buy it. But the same school of thought which favours capital outlay programmes, lays the greatest emphasis upon keeping the long term rate of interest low.

I was glad to find that Mr. Hartley Withers agreed that the Government ought not to be afraid of inflation. Mr. Samuel was of opinion that the question was mainly one of velocity of circulation. That was not at all inconsistent with the definition of trade depression that I gave, but I did not want to go into detail about the theory and particularly I should not have used the phrase "velocity of circulation" which is employed in three or four different senses.

Mrs. Robinson referred to Keynes's theory of savings. I am afraid in compressing my paper I left out a passage in which I referred to Mr. Keynes's theory of savings. It pointed out that although according to his analysis there was a big excess of savings at a time of depression, that is identified through his explanation with traders' losses. According to his definition it is the losses themselves that are savings. Savings are the same thing as investments excepting that they exclude what Mr. Keynes calls profits or losses. That is the distinction; there is nothing more in it and the difference between investment and savings is a circumlocution for the difference between prices and costs.

Mr. Crump asked whether inflation, once started, could be stopped. I am quite confident that it can, by the well-recognized methods of credit control. Fears have been expressed again and again that if depreciation were once started it could not be checked.

Depreciation has in fact started in the majority of countries, and there has not been a single case where there has been any difficulty in control; I would go so far as to say there has not been a single case in the history of the world where inflation has got out of hand in a period of less than three years.

Mr. Crump also suggested that I had taken insufficient account of the unequal incidence of depression in different industries. The abridged version of my paper may have been a little misleading, but if you double the price of every commodity, that gives relief to everyone concerned in selling. The disparity between primary and manufactured products, referred to by Mr. Ellinger, is due to the circumstance that the prices quoted for manufactured goods depend more directly upon costs and wages than the prices of primary products, and when the demand shrinks the effect is more in restriction of output than fall of prices.

If a number of industrial countries start depreciating their currencies, the effect is to reduce the cost of production of manufactured goods in terms of gold or of those currencies which remain undepreciated. That fall in costs tends to remove the disparity between manufactured goods and primary products. The fall in costs of manufactured goods increases the demand for them, not only in countries producing primary products but in all countries, and as fast as the demand for manufactured goods increases and employment increases, the demand for primary products also increases, and any such demand increases their price. The effect therefore, of currency depreciation is to remove the disparity.

I feel I must bring my remarks to a close, but I hope I may be allowed to add a few words in the Journal.

Mr. Hawtrey subsequently wrote as follows:

Sir Basil Blackett suggested that it was possible that revival in this country might induce such a rise in gold prices that the exchange value of sterling need not necessarily fall, and Mr. Pethick Lawrence supported this view. I should not altogether dissent from it, but clearly it would not be safe to rely on gold prices rising fast enough, and I note that Sir Basil Blackett agreed that we must be prepared to face a fall in sterling.

But I should go beyond that in that I would advocate a *sudden* depreciation of sterling in relation to foreign currencies and to gold as a device for giving a stimulus to industry and breaking the credit deadlock.

Mr. Pethick Lawrence suggested that a programme of public works could be started without any delay, by merely releasing from official restraint proposals which are ready to start. The question is one of fact. If there *are* such proposals in readiness, they would of course, so far as they go, offer a better prospect of the capital programme having a favourable effect. But I feel some doubt, first, as to whether such proposals as there may be in this condition represent a total outlay which is anything more than a negligible contribution to the problem, and, secondly, whether they are so ripe for immediate commencement as Mr. Pethick Lawrence supposes.

Mr. Crump expressed doubt whether exporters would gain by a depreciation of the currency. He agreed that, if home prices rose more than in proportion to the depreciation of the pound, exporters would actually lose. But what exporters are concerned about is their *costs*, which depend mainly on wages. There may be a rise in the internal price level without any rise in wages. In fact what is to be hoped from a depreciation of the currency is a rise in both internal and external price levels, accompanied by an increase of employment, but without any increase of wages (except in those unsheltered industries where wages have been disproportionately reduced). The internal price level is likely to increase less than the external, for it is kept down by the increase of output, whereas the effect of increased exports from one country in lowering the world price level would be relatively small.

Professor Jones described the policy of depreciating the currency as being directed to "increase exports, decrease imports and thereby secure an all-round improvement in the trade of the country," and he contended that, if that were so, the advantages of the policy to one country would be destroyed by extending it to other countries.

This is a complete misconception. I advocated depreciation as a device for starting a credit expansion and a rise of prices. If the rise of prices *did not occur*, then indeed the depreciation would increase exports and decrease imports. But that merely means that a favourable balance of payments would counteract the depreciation, the currency would rise again and the plan would have been a failure.

If, on the other hand, the plan achieved its object, there would be an expansion of the consumers' income, which would attract additional imports, and would require a continuance of the depre-

ciation of the currency to maintain *equilibrium* in the balance of payments. The outcome is merely the restoration of the balance between exports and imports, and therefore there is nothing inconsistent in supposing all countries to adopt the same policy.

Mr. Ellinger expressed doubts as to the possibility of removing the disparity between the price levels of primary products and manufactured products by a rise in the general level of prices, because he believed the stocks of primary products to be large even for a normal demand. If he is right, it is still true that a reduction in the purchasing power of the monetary unit, which would reduce the costs of manufacturing in terms of real wealth, would *diminish* the disparity; only there would still be a residual effect of the redundant stocks of primary products to be dealt with.

But I do not think he is right. The trouble in regard to primary products has arisen because, when demand falls off, output is not reduced. Since manufacturing output is reduced, the output of primary products becomes, and, at any rate for a time, remains redundant. When manufacturing activity revives, the output of some primary products is likely to lag behind demand, and there will be an interval when the sales from stocks will be abnormally large. How far this tendency will go towards correcting the redundancy it is impossible to say, but I should be inclined to attach importance to it.

With regard to Mr. T. W. Wyatt's written criticisms, I must confess that I am puzzled by his fear that credit "would be sterilized by a rise in Stock Exchange prices of fixed-interest securities." I should guess that he means that the sellers of these securities would delay re-investing the money they received because prices would be too high for investment to be attractive. But the effect I should hope for from the open-market purchases is an accumulation of idle cash reserves in the joint-stock banks, which would stimulate them to find borrowers, and I argued in my paper that, as the credit deadlock which appears to be complete is in reality in *any one industry* only intermittent, borrowers would be forthcoming. The high price of securities actually helps this tendency by making investments a less attractive alternative to advances. That, in case of the effect being delayed, "opposition would be aroused to stop further creation before the task was half finished" I must admit to be only too probable. That is one reason why I suggest currency depreciation as a device for securing a rapid start. Mr. Wyatt refers to recent American experience. That, I think, gives ample confirmation of this latter suggestion. Mr. Wyatt thinks I am "frightened by the Balance of Payments bogey." He is quite mistaken. A rise in the price level in terms of sterling may be expected to involve a depreciation of sterling in terms of gold and foreign currencies. I do not fear this; I think there is no harm in it. He suggests that the existence of credits in blocked accounts abroad which cannot be remitted here is evidence that our balance is "far too favourable." That is not quite the right inference. The exchange restrictions are resorted to by countries desirous of keeping their currencies at gold parity, because at that parity, with

a free exchange market, their own balance of payments would be unfavourable. Their problem is with their own balance, not with that of Great Britain or of any single foreign country.

Mr. Wyatt wants to know what I mean by "waste of money." "Where," he asks, "does it go to when it is wasted?" The answer is that money is wasted when it is paid for productive activity of which the output is not wanted, or is not valuable enough (in the broadest sense) to justify the effort spent upon it. What is wasted, of course, is not "money" but productive resources.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society:—

Edgar Walter John Cambridge.
Victor Herbert James Harvey.
Ralph Raymond Whitaker.

Corporate representatives.

John William Goss, *representing* the Calculating and Statistical Service.
Betty Fairfax Rushby, *representing* Greenly's Ltd.



MISCELLANEA.

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NOTE ON THE NUMBER OF THE JEWS IN GERMANY.

By G. UDNY YULE, F.R.S.

SOME correspondence as to the number of the Jews in Germany was published in *The Times* during March. In a letter published on March 20th Mr. E. W. D. Tennant wrote: "In 1914 there was no Jewish question and only about 400,000 Jews in Germany. Towards these acclimatized Jews, as they are called, there is still no hostility felt. The anti-Jewish movement is directed rather against the army of nearly 1,250,000 Jews who entered Germany during and after the War from Poland and Galicia."

It may be as well to comment on these figures. The statistics of religious confession in the German Census Reports of 1910 and 1925 give the following figures for the number of Jews (Israeliten):—

1910	615,021
1925	564,379

The numbers amount to 9.0 and 9.3 per 1000 of the population respectively.

As regards immigration, there is a useful table on p. 538 of the Text volume of the Report on the 1925 Census, reproduced in Table I. In round numbers, of the 1,377,000 persons 11 years of

TABLE I.

*Immigrants into Germany between 1914 and Census of 1925,
excluding children under 11 at the Census.*

Of the immigrants there formerly lived in :	Number.	Per cent. of total.
1. The Saar	37,044	2.7
2. Areas separated from Germany	769,733	55.9
3. Other European countries :	525,375	38.1
of which—(a) Eastern Europe	253,069	18.4
(b) South-eastern Europe	115,472	8.4
(c) Southern Europe	12,844	0.9
(d) Western Europe	134,065	9.7
(e) Northern Europe	9,260	0.7
4. Former German Colonies	9,102	0.7
5. Countries outside Europe	35,866	2.6
	1,377,120	100.0

age and over who had immigrated into Germany since the War, 770,000 came from areas separated from Germany under the peace treaties, some 37,000 from the Saar, and some 9,000 from former German colonies. Of the remainder, amounting to no more than 560,000, only some 250,000 are recorded as having entered from Eastern Europe. The total number of Poles recorded in Germany at the Census of 1925 was 259,804, of whom 117,683 possessed German as their mother-tongue.

TABLE II.
Marriages in Germany in the 25 years 1906-30.

Year.	Marriages in which the			All Marriages.
	Husband Jewish.	Wife Jewish.	Of which both Jewish.	
1906	4,520	4,495	4,080	498,990
1907	4,547	4,477	4,052	503,964
1908	4,330	4,423	3,907	500,620
1909	4,421	4,307	3,873	494,127
1910	4,445	4,318	3,880	496,396
1911	4,449	4,267	3,814	512,819
1912	4,480	4,316	3,833	523,491
1913	4,263	4,101	3,621	513,283
1914	3,411	3,167	2,617	460,608
1915	1,842	1,098	1,497	278,208
1916	1,893	1,658	1,292	279,076
1917	2,033	1,806	1,402	308,446
1918	2,820	2,606	2,171	352,543
1919	7,375	7,144	6,295	844,339
1920	8,812	8,393	7,497	894,978
1921	6,743	6,381	5,617	731,157
1922	6,310	5,778	5,025	681,891
1923	6,139	5,535	4,833	581,277
1924	4,329	3,838	3,310	440,039
1925	3,812	3,409	2,904	482,792
1926	3,471	3,156	2,656	483,198
1927	3,758	3,325	2,789	538,463
1928	3,985	3,585	2,983	587,175
1929	3,869	3,428	2,817	589,611
1930	3,884	3,460	2,851	562,491

The marriage statistics of Table II are compiled from the data as to marriages and the statistics of religious confession of the parties married given in successive issues of the *Statistisches Jahrbuch für das deutsche Reich*. There was a large upward movement in the number of marriages of Jews and Jewesses immediately after the War, but this is almost paralleled by a similar movement in all marriages: most of it at least was clearly due simply to postponement of marriage during the War. If we average over the ten years 1914-23, after which the figures seem to return to normality, the

figure for all marriages is 473,063, for marriages of Jews 4,738, for marriages of Jewesses 4,357. The first figure seems to fit in fairly well between the pre-war data and the figures for 1924 and following years. The figure for Jews looks markedly in excess, and for Jewesses very slightly in excess. They may indicate, in addition to the effect of postponement, some temporary immigration—immigrants who had left the country again before 1925—but the interpretation would be quite speculative, nor could such immigration in any case have amounted to much. It is evident that there has been no very material change since 1925.

In the 25 years of Table II there were 109,941 Jews married, 102,471 Jewesses married and only 89,616 marriages in which both partners were of the Jewish community. There were therefore 20,325 Jews and 12,855 Jewesses, or in all some 33,000, who had married outside the community. This gives some idea of the considerable amount of intermarriage.

As stated, all the data relate to Jews by religious confession. There is no information available—or at all events no official information—as to numbers of persons who may be Jewish by race but belong to some other religious confession. It should be added that from 1917 Alsace Lorraine is excluded, and from 1919 the portion of Posen given to the Poles, and that from 1920 onwards the data refer to the existing boundaries of the Reich and exclude the Saar.

THE ESTIMATION OF INFANT MORTALITY.

By W. J. MARTIN.

(Division of Epidemiology and Vital Statistics. London School of Hygiene and Tropical Medicine.)

THE present estimation of Infant Mortality is based on the registration and not on the occurrence of births and deaths, ignoring the greater delay in the registration of births than of deaths and taking no account of migration. The last factor probably has no influence on the death-rate and the first averages itself out when comparing one year with another. Other difficulties in obtaining an exact determination are: the numbers of births are not constant in each quarter, the probability of dying is different for each quarter and the proportional mortality varies. The distribution of the proportion of quarterly births to the yearly total for 1912-30 is, in descending order, shown in the following table. The first quarter, for example, gave the largest proportion of births in 5 years out of the 19, it stood second in 3 years, third in 10 years, and in only one year out of the 19 did it give the lowest proportion of births.

Quarter of Birth.				Largest proportion of Births.	2nd.	3rd.	Lowest.
1st Quarter	...	...	...	5	3	10	1
2nd	„	...	...	12	5	2	—
3rd	„	...	...	1	11	7	—
4th	„	...	...	1	—	—	18

The fourth quarter has the lowest number of births in any quarter except in 1919, when the sudden increase in births placed it first. The distribution of the probability of dying under one year for each quarter for the years 1912-29 is:

Quarter of Birth.				Highest.	2nd.	3rd.	Lowest.
1st Quarter	...	...	...	8	9	1	—
2nd	„	...	...	1	4	8	5
3rd	„	...	...	—	6	6	12
4th	„	...	...	9	5	3	1

The method used at present by the Registrar-General is to divide the number dying between 0-1 in the year by the number born in the year. There is a theoretical objection to this method

if the numbers born in each quarter fluctuate widely. This became a valid objection during the War and succeeding years, and to meet this difficulty the Registrar-General adopted, in 1920, a standardized death-rate and applied it to the period 1911-25.

The Government Actuary * proposed a more simple method to overcome the effects of variable quarterly totals. His method of obtaining the exposed to risk is to take $\frac{1}{8}$, $\frac{3}{8}$, $\frac{5}{8}$, $\frac{7}{8}$ of the births in the 1st, 2nd, 3rd and 4th quarters respectively in the preceding year plus $\frac{7}{8}$, $\frac{5}{8}$, $\frac{3}{8}$, $\frac{1}{8}$ of the births in the 1st, 2nd, 3rd and 4th quarters respectively of the year under consideration. This divided into the number of deaths in the year gives the probability of dying at age 0-1. This formula assumes that death occurs at random during the first year of life, but actually about 50 per cent. of the deaths occur in the first six weeks. So that it appears that the exposed to risk of any year includes a number who died in the previous year and the actual mortality is understated. A more exact statement of Infant Mortality can be obtained by a modification and combination of the method of the Registrar-General and Government Actuary. Distribute the deaths to the quarters of birth by the procedure adopted by the Registrar-General,† *i.e.* of the two possible quarters of death assign the following proportions to the more recent and the remainder to the more remote of the two—age at death under 1 day, 100 per cent.; 1-7 days, 98 per cent.; 1-2 weeks, 89 per cent.; 2-3 weeks, 81 per cent.; 3-4 weeks, 73 per cent.; 4 weeks-2 months, 54 per cent.; 2-3 months, 17 per cent.; 3-4 months $\frac{5}{6}$; 4-5 months, $\frac{1}{2}$; 5-6 months, $\frac{1}{3}$; 6-7 months, $\frac{5}{6}$; 7-8 months, $\frac{1}{2}$; 8-9 months, $\frac{1}{6}$; 9-10 months, $\frac{5}{6}$; 10-11 months, $\frac{1}{2}$; 11-12 months, $\frac{1}{6}$. By subtracting from the births of each quarter the infants who died in the same calendar year as they were born, the number of survivors at the end of the year from each quarter is obtained. To obtain the denominator take $\frac{1}{8}$, $\frac{3}{8}$, $\frac{5}{8}$, $\frac{7}{8}$ respectively of the survivors from the 1st, 2nd, 3rd and 4th quarters of the previous year plus $\frac{7}{8}$, $\frac{5}{8}$, $\frac{3}{8}$, $\frac{1}{8}$ of the births of the 1st, 2nd, 3rd and 4th quarters of the year under consideration. This divided into the number of deaths during the year gives the probability of dying at age 0-1.

The method propounded above is laborious, and furthermore we are not always in the happy position of having the deaths given in the necessary detail to allow them to be referred to the quarter of birth. An alternative method would be to use proportional mortality. This presents some difficulties, since the decline in the

* Registrar-General's Decennial Supplement, England and Wales. 1921. Part I. Life Tables.

† Annual Report of Registrar-General, England and Wales. 1920.

Infant Mortality affects the older infants more than the younger, so that the proportion of deaths occurring in the first few weeks is increasing. Also the 2nd and 3rd quarters show a higher proportion of deaths in the first weeks of life than do the 1st and 4th quarters. Ignoring the variations between the quarters and considering the yearly totals only, the period 1913-30 may be divided into three sections, 1913-18, 1919-25 and 1926-30. The proportions dying in each of the $1\frac{1}{2}$ monthly periods are :

	0-.	$1\frac{1}{2}$ -.	3-.	$4\frac{1}{2}$.	6-.	$7\frac{1}{2}$ -.	9-.	$10\frac{1}{2}$ -.
1913-18 ...	42.7	12.6	9.4	7.9	7.3	7.0	6.7	6.4
1919-25 ...	49.7	11.9	8.3	6.8	6.3	6.0	5.7	5.3
1926-30 ...	50.9	12.0	7.2	6.9	6.0	6.0	5.5	5.5

The following is an illustration of the method. The distributions of the births for 1912 and 1913 are :

	1st quarter.	2nd quarter.	3rd quarter.	4th quarter.	Total.
1912 ...	222,600	218,070	219,232	212,835	872,737
1913 ...	216,629	227,470	225,501	212,290	881,890

In 1913 the deaths under one year were 95,608. The value of q_0 is required.

Of the $q_0 \times 222,600$ deaths among the 1st quarter 1912 births,
 $q_0 \times 222,600 \times 6.4$ will occur in 1913.

Of the 2nd quarter's births, $q_0 \times 218,070 \times 20.1$ will occur in 1913.

„ 3rd „ „ „ $q_0 \times 219,232 \times 35.3$ „ „ „

„ 4th „ „ „ $q_0 \times 212,835 \times 57.3$ „ „ „
 $= q_0 (257,421.821)$. The total deaths must be
 $q_0 (872,737)$.

$\therefore 0.2949592$ of infant deaths belonging to 1912 occur in 1913.

Now multiply 216,629 227,470 225,501 212,290 by
 respectively 93.6 79.9 64.7 42.7

and we reach $q_0 (621060.251)$.

The total deaths must be $q_0 (881,890)$.

\therefore ratio is 0.7042378 .

$\therefore 95,608 = q_0 (0.2949592 \times 872,737 + 0.7042378 \times 881,890)$.

$\therefore q_0 = \frac{95,608}{878482.0808} = 0.1088$.

When the deaths are given for the year only, the alternative method to that of the Registrar-General is to allot 30 per cent. of the deaths to the previous year and 70 per cent. to the current year. This gives good results even when the actual figures are not

quite 30 per cent. and 70 per cent. The actual proportions for 1911-30 are :

	Percentage of died born in :	
	Preceding year.	Current year.
1911	30-15	69-85
1912	30-23	69-77
1913	29-68	70-32
1914	30 09	69-91
1915	35-17	64-83
1916	29-12	70-88
1917	33-64	66-36
1918	31-15	68-85
1919	31-71	68-29
1920	27-37	72-63
1921	27-60	72-40
1922	31-47	68-53
1923	28-47	61-53
1924	30-86	69-14
1925	28-55	71-45
1926	28-20	71-80
1927	31-39	68-61
1928	26-97	73-03
1929	32-95	67-05
1930	25-17	74-83
1911-30	30-18	69-82

The results of these various methods of estimation are given in the table on p. 485.

If column 1 is taken as the standard, the other methods understate the Infant Mortality; the errors in the Government Actuary's method vary from 2 to 3 per cent., the other three systems being more irregular. Of the two years, 1919-20, when the fluctuations in the births were greatest, the method of proportionate mortality gives the worst estimate for 1920 and the 30 and 70 per cent. distribution the worst for 1919.

If the Registrar-General's values are accepted as a standard—and there are many reasons for this: precedent, familiarity and the universal applicability of the non-standardized death-rates—the proportionate mortality gives a smaller error than the other two schemes. During the period 1913-25, when the Registrar-General standardized his death-rates, the difference of the proportionate mortality exceeded $\frac{1}{2}$ per cent. only once, in 1920. For the last five years when the usual method was employed by the Registrar-General the differences are slightly larger. The large difference for 1927 is due to the fact that this year showed a large decrease, 40,391, in births compared with 1926, but the number of births in 1928

Year.	Method of obtaining Infant Mortality					Differences expressed as a percentage of column (1).					Differences expressed as a percentage of column (3).		
	Modified Registrar-General and Government Actuary.	Government Actuary.	Registrar-General.	Proportional Mortality.	30 and 70 per cent. Distribution.	(1)-(2).	(1)-(3).	(1)-(4).	(1)-(5).	(3)-(2).	(3)-(4).	(3)-(5).	
	(1).	(2).	(3).	(4).	(5).								
1913	0.1123	0.1092	0.1089	0.1088	0.1088	2.8	3.0	3.1	3.1	-0.28	0.09	0.09	
1914	0.1077	0.1043	0.1044	0.1044	0.1045	3.2	3.1	3.1	3.0	0.10	0	-0.10	
1915	0.1073	0.1039	0.1058	0.1061	0.1073	3.2	1.4	1.1	0	1.80	-0.28	-1.42	
1916	0.0936	0.0908	0.0911	0.0910	0.0902	3.0	2.7	2.8	3.6	0.33	0.11	0.99	
1917	0.0908	0.0881	0.0911	0.0913	0.0922	3.0	-0.3	-0.6	-1.5	3.29	-0.22	-1.21	
1918	0.1010	0.0983	0.0979	0.0979	0.0969	2.7	3.1	3.1	4.1	-0.41	0	1.02	
1919	0.0987	0.0958	0.0932	0.0930	0.0903	2.9	5.6	5.8	8.5	-2.79	0.21	3.11	
1920	0.0886	0.0866	0.0845	0.0827	0.0891	2.3	4.6	6.7	-0.6	-2.49	2.13	-5.44	
1921	0.0817	0.0796	0.0812	0.0812	0.0799	2.6	0.6	0.6	2.2	1.97	0	1.60	
1922	0.0752	0.0732	0.0747	0.0750	0.0752	2.7	0.7	0.3	0	2.01	-0.40	-0.67	
1923	0.0705	0.0689	0.0692	0.0692	0.0688	2.3	1.8	1.8	2.4	0.43	0	0.58	
1924	0.0754	0.0737	0.0742	0.0744	0.0743	2.3	1.6	1.3	1.5	0.67	-0.27	-0.13	
1925	0.0759	0.0742	0.0745	0.0746	0.0744	2.2	1.8	1.7	2.0	0.40	-0.13	0.13	
1926	0.0710	0.0694	0.0702	0.0698	0.0697	2.3	1.1	1.7	1.8	1.14	0.57	0.71	
1927	0.0690	0.0674	0.0697	0.0685	0.0685	2.3	-1.0	0.7	0.7	3.30	1.72	1.72	
1928	0.0668	0.0655	0.0651	0.0653	0.0653	1.9	2.5	2.2	2.2	-0.61	-0.31	-0.31	
1929	0.0751	0.0735	0.0744	0.0739	0.0738	2.1	0.9	1.6	1.7	1.21	0.67	0.81	
1930	0.0617	0.0604	0.0600	0.0602	0.0601	2.1	2.8	2.4	2.6	-0.67	-0.33	-0.17	

showed an increase of 6,095 over 1927; this has the effect of causing the Registrar-General's method to overstate the Infant Mortality for 1927 and understate it for 1928. The 30 and 70 per cent. distribution gives as small a difference as or a smaller difference than the Government Actuary's scheme for 13 out of the 18 years, but for 1920 the difference is twice as great as that of the Government Actuary.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS.

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1.—*Approximation and Graduation according to the Principle of Least Squares by Orthogonal Polynomials*. By C. Jordan. *Annals of Mathematical Statistics*, 1932. Vol. 3, pp. 257-357.

On the Graduation of Data by the Orthogonal Polynomials of Least Squares. By A. C. Aitken. *Proceedings of the Royal Society of Edinburgh*. 1933. Vol. 53, pp. 54-78.

The nature of the general problem of the fitting of orthogonal polynomials to observational data by the method of least squares must by now be familiar to readers of this *Journal*. What is possibly the first reference to the methods in the statistical literature of this country is contained in a note published in 1920 (Vol. 83, p. 328), wherein the form, for equidistant data, of the first three Tchebychef polynomials is given. Rhodes reviewed a paper by Jordan in 1930 (Vol. 93, 569-572), and added a numerical illustration of his methods, while Irwin, in an article "Recent Advances in Mathematical Statistics" (1931, Vol. 94, 568-578), gave a short résumé, with references, of the more important of the contributions that had been made to the subject, arising out of his discussion of a paper by Allan.

The foundations of the theory were laid by Tchebychef in papers published between 1854 and 1859 (also later papers), and it is important to note that he dealt with the case where the observations are not necessarily at equal intervals. If we add to this

that the observations may be of unequal weight, we have the most general case, a solution of which furnishes us with all we require for work on skew regression. In this connection see a paper by Pearson in 1921 (*Biometrika*, Vol. 13, 296-299). Isserlis gave in 1929 a very useful account, with references, of the work of Tchebychef and others (*Biometrika*, Vol. 19, 87-93), and his is still the best paper to go to for a rapid appreciation of the numerical methods of dealing with non-equidistant and unequally weighted data. On the whole, however, it is in the special case of equidistant unweighted ordinates, applied to the study of trends in economic and other data, that much work along the lines of simplifying the numerical processes, and perhaps also the algebraic derivation of the formula, has been done.

Two papers of importance in this connection have recently appeared. In the *Annals of Mathematical Statistics*, 1932, Vol. 3, 257-357, there is a paper by C. Jordan: "Approximation and Graduation according to the Principle of Least Squares by Orthogonal Polynomials," stated to have been read before the 93rd annual meeting of the American Statistical Association on 28 Dec., 1931. Jordan has a number of papers on this subject to his credit. The first was published in the *Proceedings of the London Mathematical Society* (1921, 2, 20, 297-325), and now after papers in French, Hungarian and German he has crowned his work by a long paper in English. Making effective use of the calculus of finite differences, he develops the theory in full, and shows how to build up general expressions for the orthogonal polynomials in factorial form. The general formula for the r th polynomial can be given comparatively simply in terms of a series of factorial polynomials in x , the independent variable, and since differences play the same rôle to these as differentials do to power series, expressions for the value of the polynomial expansion to any given degree, at $x = 0$, and the advancing differences at this point, follow naturally, thereby suggesting a numerical method of building up the theoretical polynomial values by successive adding on of differences. Jordan furnishes tables for direct numerical application of his methods which go up to $n = 100$, and goes on to study the related problems of fitting polynomials to sets of two or more correlated variables, and of graduation of series.

Jordan's numerical methods may be said to have been complete by 1930 (see paper by Rhodes referred to above), although certain improvements have now been introduced. He gives many references to the literature of the subject, but curiously enough no mention is made of the work of R. A. Fisher. He has since written to say that at the time he was unaware of Fisher's contributions to the subject. Fisher first developed the methods, independently of previous authors, in 1921 (*Jour. Agric. Sci.*, Vol. 9, 107-135). In a later paper (1924—*Phil. Trans. Roy. Soc.*, B 213, 89-142) he refers to independent work by Esscher (1920—*Meddel. Lunds Astr. Observ.*, 2, 23, 10-21). These two papers are complete as far as concerns the calculation of the Tchebychef polynomials by formulæ based on successive summation of the original values, and their expression

up to the fifth degree. His general expression, and the method of building up the polynomial values from their differences, were given in 1930 in the third edition of his book *Statistical Methods for Research Workers*. Proofs, and explicit formulæ up to the tenth degree, were given in a paper of the same date by Allan (*Proc. Roy. Soc. Edin.*, 50, 310-320). The latter gives Jordan's formula as one of her forms, the subsequent modification being to refer the formulæ to a central origin.

In another respect Jordan seems to have been unaware of earlier English work. He shows how to obtain the factorial moments by successive summation of the observed values, this being, in fact, a fundamental stage in the work. But he attributes the method to Tchétverikoff, in a paper published in Russian in 1926. This method of calculating the factorial moments, however, was invented by Sir G. F. Hardy, the actuary, many years ago. Elderton, in *Frequency Curves and Correlation* (1st ed., 1906, 19), states that the method was used by Hardy in his *Graduation of British Offices Tables, 1863-93*. The latter described the method in *Construction of Tables of Mortality* (1909), and it has been in use ever since. The importance of the factorial moments as such was perhaps not recognized in those early days, for the method was given for the calculation of the ordinary power moments; nevertheless it was the factorial moments which represented the first stage in the calculation. The same method, in principle, was used by Fisher.

Another important paper is that of A. C. Aitken: "On the Graduation of Data by the Orthogonal Polynomials of Least Squares" (*Proc. Roy. Soc. Edin.*, 1933, Vol. 53, 54-78). We have here not only what is probably the simplest possible demonstration of the theory, but also a description of the numerical processes which, with the aid of the tables provided, renders the operations almost completely automatic. Briefly described, the method is as follows. The factorial moments are first obtained by successive summation. These are then placed in a column alongside the appropriate triangular table for the given value of n (the number of observations). Simple arithmetical operations on the columns of the table yield the coefficients of the Tchebycheff polynomials, and at the same time the sum of squared residuals is found by successive subtraction from the crude sum of squares of observed values, whence on dividing by the number of degrees of freedom a clue is found as to the degree to which the polynomial must be fitted to eliminate the trend. The actual values of the polynomials, in factorial form, are obtained from the table itself. Similar operations on the rows of the table give the first (and last) polynomial values, and the advancing differences, whence finally the theoretical values corresponding to those observed are built up by a process of summation of differences. Adequate checks are provided to ensure accuracy in computation. The tables are provided up to the fifth degree, and to $n = 25$, but the method of constructing a complete table *ad hoc* for any value of n is described, an operation which is very simply carried out.

With Aitken the numerical methods may be said to have reached the quintessence of simplification in operation. But he goes further.

Realizing that the Tchebychef polynomials assume a more compact form when the data are referred to a central origin (a point already taken up by Fisher), and when central or mean central factorial polynomials are used, he shows how to sum the observed values from the extremes towards the centre, and to use the resulting moments with a new set of tables in exactly the same way as before. The advantage is that the new tables have every alternate entry zero, which much reduces the labour of computation. The operations on the rows of the table yield central and mean central differences, whence by summation in two pieces the required polynomial values are obtained. As before, the tables go up to the fifth degree and to $n = 25$, but they are easily extended as required. Examples are given for both an odd and an even set of data, and the routine processes are easily followed. It should be added that apart from the halving of the work in the second stage, the summations in the first stage in two pieces lead to much smaller totals. The advantage of this is very great when the series is a long one, and when fitting has to be carried out to a high degree. Long ago, of course, Fisher suggested such a splitting of the summation work to avoid large numbers, but this device was only used by him to ease the labour of obtaining the final summations, and there is a further gain to be derived from expressing the results in central factorial notation. The splitting in Fisher's work could, in fact, be done at any arbitrary point in the series. Mention should also be made at this stage of a numerical process described by Stephan (*Jour. Amer. Stat. Assoc.*, 1932, 27, 413-423), wherein summation from the extremes to the centre is advocated.

It would take up too much space to furnish illustrations of all the methods that have been described in this note, but one example will not come amiss. We shall show how Aitken's second, or central, method may be applied to a short series of numerical values. A cubic will be fitted to the following eight equidistant values of u —22, 13, 11, 21, 45, 52, 60, 54. A longer series, such as would occur in practice, would merely involve longer summations in the initial and final stages, while the usual practical problem would also involve determining the appropriate degree to which a polynomial ought to be fitted, a thing that is done by studying the reduction in the mean of the squared residuals, and if necessary carrying the summations to one or two further stages. The calculations are set out in order on page 491.

The computation is almost self-explanatory. The entries in the first table are obtained by successive addition of the number on the left to that in the previous line, working from opposite ends to the middle, and stopping a half stage short each time, the numbers in brackets being got by adding on only half the number in the previous column. The table for $n = 8$ is then bordered with a column of moments, these being the alternate sums and differences of the central entries in the first table. The coefficients a are then calculated, e.g. $a_1 = (2 \times 303)/168$, $a_2 = (6 \times 738 - 15 \times 278)/1512$, etc., and placed above the appropriate column. At the same time the reduction of Σu^2 is shown by stages. It will be noticed that the

x .	u .	Σ .	$\mu\Sigma^2$.	Σ^3 .	$\mu\Sigma^4$.	u^2 .
$-\frac{7}{2}$	22	22	22	22	22	484
$-\frac{5}{2}$	13	35	57	79	101	169
$-\frac{3}{2}$	11	46	103	182	(192)	121
$-\frac{1}{2}$	21	67	(136.5)			441
$\frac{1}{2}$	45	211				2,025
$\frac{3}{2}$	52	166	(439.5)	556		2,704
$\frac{5}{2}$	60	114	168	222	(554)	3,600
$\frac{7}{2}$	54	54	54	54	276	2,916
						12,460

a				μV_0 .	δW_0 .	$\mu\delta^2 V_0$.	$\delta^3 W_0$.
	34.75	3.607	0.1706	-0.28030			
m	1	2	-15	32.19	15.62	1.024	-5.6060
			-30				
			6				
			20				
$\Sigma(T^2)$				8	168	1512	6600

	$a, \Sigma u T_i$	12460.0.	S^2 .	$S^2 \div$ $(n-i-1)$.
$a_0 = 278/8 = 34.75$	$278^2/8 = 9660.5$	2799.5	399.93	
$a_1 = 606/168 = 3.607$	$606^2/168 = 2185.9$	613.6	102.27	
$a_2 = 258/1512 = 0.1706$	$258^2/1512 = 44.0$	569.6	113.92	
$a_3 = -1850/6600 = -0.2803$	$1850^2/6600 = 518.6$	51.0	12.75	

x .	V .	δV .	$\delta^2 V$.	W .	δW .	$\delta^2 W$.	$\delta^3 W$.
$\frac{1}{2}$	32.19	0	1.024	(-7.81)	15.62	(2.803)	-5.606
$\frac{3}{2}$	33.21	1.024	1.024	7.81	12.82	-2.803	-5.606
$\frac{5}{2}$	35.26	2.048	1.024	20.63	4.41	-8.409	-5.606
$\frac{7}{2}$	38.33	3.072		25.04	-9.61	-14.015	
				15.43			

									Total.
u	22	13	11	21	45	52	60	54	278
U	22.90	10.22	12.58	24.38	40.00	53.84	60.30	53.76	277.98
	$\Sigma(u - U)^2 = 50.99.$								

parabolic term does not improve the fit, but the cubic makes a great deal of difference, thus emphasizing the desirability of proceeding two further stages before being satisfied with the fit. The central and mean central differences at 0 are next calculated from the rows of the table, e.g. $34.75 - 15 \times 0.1706 = 32.19$, etc. Finally, these values are used in the last stage to build up the function $U = V \pm W$. The totals of u and U agree closely, while $\Sigma(u - U)^2$ by direct calculation is almost exactly equal to the final value of S^2 . If required the equation to the cubic may be written as

$$U = 34.75 + 3.607(2x) + 0.1706\{6(x^2 - \frac{1}{2})/2! - 15\} - 0.2803\{20x(x^2 - \frac{1}{2})/3! - 30x\},$$

the coefficients 2; 6, -15; 20, -30, being obtained directly from the table.

J. W.

2.—*Statistik im Dienste der Technik*. Von Dr.-Ing. Emil Kohlweiler. München and Berlin: R. Oldenbourg, 1931. $9\frac{1}{2}'' \times 6\frac{1}{2}''$. xv + 441 pp. Rm. 22.

Industry has always used statistical methods of sorts. No concern could survive six months without figures of output, material and power consumed, and waste. Considering the information accumulating in factory and testing-house records and the importance of savings in production costs, it is surprising that these figures have not been exploited to better advantage. Here is room for propaganda work. Statistical methods have been revolutionized during the last ten years and the technique of small samples provides what was lacking to make quality control of manufacture effective. What is most needed is actual industrial material upon which to experiment, and great difficulty is found in coaxing it out of the hands of those who possess it. This is due partly to the traditional secrecy of British manufacturers, partly to the statistician's failure to give an intelligible account of what he is after and to show that his methods afford a reasonable prospect of discovering facts undiscoverable by plain inspection.

Fortunately the situation has now been taken in hand. As already reported in the *Journal*, a Committee of the British Standards Institution (upon which this Society is represented) is now engaged in drafting a pamphlet which should go far to resolving doubts as to the capabilities of statistical methods in this field.

The basis of all these investigations is the analysis of the data so as to distinguish between fluctuations due to constant systems of chance causes and those due to assignable causes. It is the technician's business to eliminate the latter so far as is commercially profitable: the former are supposed to be irresolvable in the current state of information on the subject. The ultimate object of the method is the production of an article uniform in quality and compliant with prescribed standards. Dr. Kohlweiler's book deals with statistical methods as applied to industry, with especial reference to wire manufacture. It contains a detailed explanation of the elementary technique of frequency distributions, together with a valuable mass of industrial material. The author relies largely upon the binomial distribution even for continuous variates and shows great ingenuity in extracting tangible results from unpromising material. His book is not, however, likely to command much attention in this country. It is much too diffuse, and some of the methods recommended have been superseded. There is nothing in it to compare with the work on similar lines already done in this country, and the name of R. A. Fisher is not even mentioned. An additional obstacle is the notation, which is entirely different from anything to be found elsewhere.

L. R. C.

3.—*Forecasting Business Cycles*. By Warren M. Persons, Ph.D., Consulting Economist, formerly Professor of Economics, Harvard. New York: Wiley, 1931. $9'' \times 6''$. xiv + 295 pp. 22s. 6d.

This book is an attempt to arrive at a realistic solution of the business forecasting problem. Chapters I to V of Part I give an

analysis of the business situation in October–December, 1930, and the forecasts *made at the time* of the then probable future course of business. The concepts of “probable future developments in business” are there described as “future” with respect to the dates of writing. They contain no element of “hindsight.”

“A forecast,” continues Dr. Persons, “is certainly formulated on the assumption that no important (with respect to business) *unpredictable* accident will occur to greatly stimulate or depress business; but in fact such accidents *may* occur. The forecaster should not be debited when accidents do occur. Neither should he be credited. . . . A risky guess is not a good forecast. . . . Before many months these forecasts, as *forecasts* of probable future developments in business, will be out of date. But they will never be out of date (a) as illustrations of actual practice in forecasting business cycles according to the methods described and (b) as records of forecasts which, when added to future records similarly made, will ultimately constitute material for judging the usefulness of such forecasts.”

Part II presents the graphic and tabular records of monthly and annual statistics and the historical records of important economic and political and other events and developments considered essential for formulating concepts of the probable cyclical movement of business in the United States, whilst Part III discusses the problem of economic and probability analysis.

Now that all our economic theories are likely to go into the melting-pot, it is unprofitable to go back and check up predictions of recovery that have failed to materialize. From our superior standpoint of to-day it is quite easy to see why. Forecasting methods imply that things will go on as before, that the economic machine can be kept in continuous motion by timely repairs and judicious application of lubricants. What people did not foresee was that the old machine was past the running repairs stage and that it would wheeze and groan and clank to a virtual standstill. Shortly it will be laid out on the bench for the inspection of the World Economic Conference, and its proprietors will have to decide whether (a) it can be patched up with a semblance of activity or (b) whether a brand-new 1933 model will have to be substituted. In either case new rules for working the machine must be devised and the question why it broke down under the old system becomes academic.

Dr. Persons’s book contains a wealth of invaluable material, but whether it can be utilized in the fashion he imagined remains open to doubt.

L. R. C.

4.—*Business Forecasting and its Practical Application*. By William Wallace, M.Com. 3rd ed. London: Pitman, 1932. 8½" × 5½". xx.+ 128 pp. 7s. 6d.

The comparative scarcity of works on business forecasting by British authors in contrast with the bewildering variety provided by America is mainly due to two reasons: (i) the paucity of suitable data from which to build up an index of business activity for the United Kingdom compared with the wealth of material available

to the American writer, and (2) the limited market for such books in this country. Mr. Wallace's book was first published in 1927, and the fact that it has already reached a third edition is indicative of the growth of interest in the subject which has taken place in recent years. In his preface to the present edition the author points out that in view of the abnormal economic conditions in this country and in the world at large the question might justifiably be asked whether any theory of forecasting could possibly be worthy of consideration. His answer to this question is that we cannot afford to neglect anything which will help us to take a view of the future.

The revision has been thorough; revised charts have been added illustrating conditions up to the end of 1931, while forecasting theories have been reconsidered in the light of events between 1927 and 1931. The fact that the author did not feel justified in altering, however slightly, his ultimate conclusions bears testimony to Mr. Wallace's belief that in spite of unforeseen economic earthquakes and landslides, forecasting can claim to be of use to the business world.

The general plan of the book has been retained. After dealing with the theory of the business cycle and forecasting, the author discusses the methods of the chief American forecasting services as well as the London and Cambridge Service and then passes to the application of the forecast to production, sales, distributing and advertising policies, and later deals with forecasting prices and investment forecasting. A useful appendix gives particulars of the chief sources of information and economic data in this country, together with a brief bibliography of works (mainly American) on the subject of forecasting. The book does not claim to be more than an introduction to the subject, a purpose which it achieves admirably. As Sir Walter Layton says in his introduction, "Perhaps the greatest merit of this book is that it sets out the limitations as well as the merits of the apparatus which it describes and clearly shows the business man in what way it may be applied to his particular daily problems."

G. R. W.

5.—*Booms and Depressions*. By Irving Fisher, LL.D. London: George Allen and Unwin, Ltd., 1933. 8" × 5½". xxii + 258 pp. 8s. 6d.

When the economic historian of the future attempts to compile a bibliography of the literature based on the 1929-193(?) depression he will discover an embarrassing wealth of material at his disposal. Finding himself compelled to make a selection of the works available it is probable that he will find the greatest interest attaching to those which were written and published at the very depth of the depression. Compared with the books written in the earlier stages, he will find a much closer agreement regarding diagnosis, although the remedial methods prescribed will still be as divergent as they are numerically bewildering.

Although the title does not betray the fact, this latest work of Professor Irving Fisher is primarily concerned with the present

depression. The book is divided into three parts: the first—Theoretical—deals with the nine main factors which appear to the author to be the outstanding influences in the present, as well as in most, if not all, other major depressions; the second part—Factual—gives an account of the events that led up to the present depression, while the third part—Remedial—discusses the various remedies which might be applied.

Dr. Fisher's starting-point and the spectre which he constantly keeps before our eyes is the debt structure. Over-indebtedness or the discovery of over-indebtedness—the margin of safety is an ill-defined and uncertain “twilight zone”—is always followed by attempts at correction, attempts which by their very nature bring other factors into play and help to give impetus to the overbalancing debt structure. From over-indebtedness and debt liquidation the author leads on to currency contraction, the price level, net worth reduction, profit reduction, lessened production, trade and employment, the psychological factor, pessimism and distrust, retarded circulation of currency and lowered money interest (but raised real interest)—the various main factors in a depression. Great stress is laid on the “money illusion” or the “dollar disease”—falling prices accompanied by an increase in real debts, and when Dr. Fisher passes on to discuss the present depression he points out that “the whole tragedy is summed up in what happened to the real dollar. From 1929 to March 1932 by reason of the lowering price level, the real dollar, measured by 1929, became \$1.53—later (third week of June, 1932) \$1.62.” Liquidation between 1929 and 1932 resulted in a nominal reduction of total debts in the United States by 16 per cent., whereas if measured in 1929 dollars the debts actually increased by 29 per cent. Thus in spite of the liquidation accomplished, unpaid balances were more burdensome in 1932 than in 1929.

In the final section—Remedial—the author discusses various remedies, his concluding chapter being devoted to the economist's millennium, “stable money.”

Just when the reader is regretting that Dr. Fisher has failed to offer his own prescription he discovers tucked away among the eight appendices “An outline of complete stabilization programme which if adopted would provide stabilization expedients sufficient to meet all circumstances which could reasonably be expected to arise.”

G. R. W.

6. —*Business Budgets and Budgetary Control.* By A. W. Willsmore, London: Pitman, 1932. 8 $\frac{3}{8}$ " \times 5 $\frac{3}{4}$ ". xiv + 230 pp. 10s. 6d.

Mr. Willsmore is budget officer to the Standard Telephones and Cables, Ltd., and in writing what is claimed to be the first book on the practical application of budget control to business to be produced in this country, he does so from a strictly business standpoint. Realizing that it is impossible to lay down hard-and-fast rules which would be applicable to every industry or even to different firms in the same industry, the author treats his subject from the view-point of its most comprehensive application to a highly developed, large-

scale manufacturing enterprise, pointing out that it is not always necessary or advisable for budget control to be carried to these lengths, the idea being to fit the budget plan to the needs of the individual company, rather than to adjust the operation of the company towards some preconceived technique.

The essential prelude to budgetary control is a forecast of business prospects and market conditions, but this book is not concerned with actual business forecasting, but with the application of such forecasts. Separate consideration is given to the sales budget, the production budget, the expense budget and the financial budget, before these are linked together into the general question of budget administration.

Those who have had occasion to investigate market conditions in a particular area may find it difficult to agree with the author when he says, "The essence of the problem does not lie in the mere collection of statistics of population, wealth, standards of living, trade and production for the area under review. *Such figures can usually be obtained with little trouble from official publications or similar sources. . . .*" (the italics are ours). It is frequently found that it is the absence of the bulk of this kind of information regarding individual areas of the country which make it extremely difficult to provide the necessary background for forecasting without which budgetary control cannot be brought into operation. If, however, we can provide the background Mr. Willsmore tells in a very lucid and exhaustive manner how to make the maximum use of it.

G. R. W.

7.—*Stable Money. The Remedy for the Economic World Crisis. A programme of Financial Reconstruction for the International Conference, 1933.* By Robert Eisler, Ph.D., Late Assistant-Director of the League of Nations Universities Interrelation Office, Paris; Fellow of the Austrian Institute of Historical Research at Vienna University, etc. With a preface by Vincent C. Vickers, Director of the Bank of England, 1910-1919; Chairman of the Monetary Committee of the Central Chamber of Agriculture; Deputy Lieutenant of the City of London, etc. London: Search Publishing Co., 1932. 8½" × 5½". 313 pp. 15s. net.

Dr. Eisler's object in this book is not only to show how the present depression may be cured; he aims at the even more ambitious goal of devising a scheme which will permanently prevent the major trade fluctuations and will keep industry employed at approximately the maximum level. He starts from the basis that if the present depression is to be remedied it is essential that prices should be raised, but unlike many "reflationists" he realizes that this alone can be no permanent cure, since it reduces the purchasing power of large sections of the community. The essential question he has set out to solve is whether it is "possible to organize an expansible currency with a monetary unit having constant and stable purchasing power."

To approach such a problem from the point of view of a single country is obviously doomed to failure from the outset. Dr. Eisler

therefore propounds a scheme for pegging the exchanges on lines analogous to that adopted for stabilizing the Anglo-Egyptian exchange. He envisages a series of bilateral agreements within a monetary union. The members of this union would acquire sterling exchange reserves either through their savings or through officially raised loans. There would then be an exchange of Treasury Bills between this country and the government of each member country, and these "two signature" bills would be negotiable in London and in the capital of the country concerned. Such a scheme would mean a stable exchange within the area, it would set in motion loans to the more impoverished countries that joined the union, and it would involve international inflation, in itself assumed to be desirable. Dr. Eisler recognizes the increased burden on the "off gold" area of debts due to countries still on gold (amongst which U.S.A. was included at the time of writing), but after an interesting analysis, primarily of the gold debts of the British Empire compared with its gold production, he concludes that this objection is less than might appear. Safeguarded by a series of pegged exchanges, the countries of the monetary union would then inflate, preferably by means of loans for public works.

It is at this point that Dr. Eisler attacks his scheme for stabilizing purchasing power in the face of rising prices. He proposes that there should be legislation to provide that every monetary obligation in force at a given date (wages, interest, commercial bills, insurance, etc.) should be carried out with due regard to the actual purchasing power of the national money, which would be ascertained by means of an index-number of retail prices, determined weekly. He would then introduce two sets of money, what he calls "money banco," which would be a purely theoretical unit of account, and "current money," which would be used for the payment of wages and small transactions and which would have a varying value in relation to "money banco" to be fixed according to the weekly index-number.

There is much in this scheme of exceptional interest, but Dr. Eisler is eminently light-hearted about the difficulties, both international and internal. Because some countries have made use of a gold unit of account alongside of a depreciated currency as a temporary expedient, Dr. Eisler seems to conclude that there are no drawbacks to this arrangement, but one's imagination boggles at the thought of the old lady in the village sweet-shop working out prices on weekly conversion tables. Perhaps even more important is the difficulty, which he also glosses over, of satisfactorily estimating the index-number. An index-number, for example, based on working-class budgets, is not fundamentally suitable to the conditions of living of the professional man striving to send his sons to an expensive public school or faced with heavy doctor's bills. This and similar aspects of the cost of living bonus, even with its present limited application, have already roused considerable feeling, and if the use of index-numbers was applied to the extent suggested by Dr. Eisler, such criticism would become increasingly important. Clearly, the calculation of the index-number in his economy could be adjusted so as either to perpetuate or minimize differences in the varying

social standards of living, and it would inevitably become a major political question. It may be the issues are so important that it is worth while to grapple with these very serious practical difficulties, but Dr. Eisler does his case no good by ignoring them. There are also other criticisms of his scheme of a more theoretical nature. For one thing it is devised solely with the object of counteracting the drawbacks of inflation; it is quite unsuitable to a time of real shortage when purchasing power must be reduced (*e.g.* during a war) or to a period of falling prices due solely to increased technical efficiency, when the stabilizing of purchasing power is the last thing to be desired. Moreover, it is a scheme obviously inspired by the existence of unutilized capital, and Dr. Eisler never considers how capital, using the term to include bank credit, is to be finally equated with savings. The idea that inflation is a desirable thing, the evils of which can now be overcome, might very easily lead to an over-production of capital goods, with effects on the whole balance of the national economy which the stabilized purchasing power could not counteract.

These remedies for the present evils of the world are put forward in the second part of the book. The first part gives an analysis of the present situation and its causes. Reading it one is left with an impression that inflation, deflation and technical improvements are all so certain to produce unemployment that it is difficult to see why we should have ever had any upward swings in the trade cycles. Dr. Eisler is obviously deeply moved by the present combination of unsaleable goods and deprivation in the world and is quite unable, and probably would not wish, to survey the ground with anything approaching academic calm. Full as this part of the book is of facts and figures, there is nevertheless such an impression of intolerance for those who do not see the problems with his eyes, that it is likely to rouse at times a definite feeling of antagonism in the reader, but it is worth ignoring this element in the first part for the sake of much that is stimulating and suggestive in the second part.

W. A. E.

8.—*The Gold Standard in Theory and Practice.* By R. G. Hawtrey. 3rd edition. London: Longmans, 1933. 7 $\frac{1}{4}$ " \times 5"; 248 pp. 5s.

This volume contains exactly twice as many pages as the first edition (briefly noticed in the *Journal*, vol. 90, p. 798). Mr. Hawtrey now presents us with a full account and a closely reasoned interpretation of the monetary vicissitudes of the years 1927–1932, completed by a discussion of future policy, to which the four lectures originally comprising his book may be said to form a theoretical and historical introduction. The second edition (reviewed in vol. 94, p. 339) covered the period 1927–1931 in a new chapter (V); in the third two more have been added. Chapter VI begins with the results of the suspension of the gold standard by this country, which "for the moment . . . broke the vicious circle" of deflation. The movements of the principal currencies and of gold are carefully followed, and the reasons why the circle, after a time, closed again

are analysed and expounded in detail and at length. "The effect of a depreciation of the currency upon productive activity is a matter which is often misunderstood," and Mr. Hawtrey devotes a large part of this chapter to an exposition of the "causal sequence" when currency depreciation begins the process and also when it originates with a relaxation of credit, exhibiting the actual occurrences as a working model. He reiterates the disadvantages which have resulted from the action of the financial authorities in keeping the pound at too high a level instead of allowing it to depreciate in accordance with the fall in gold prices which was continuous throughout 1932. "It has, in fact, been impossible to retain the advantages of stable rates of exchange among the currencies that have departed from gold, because the standard of value set by the pound has been much too high." Mr. Hawtrey suggests that by June 1932 the true equilibrium level of the pound was about 50% of parity, whereas it then actually averaged 75%. The logical outcome of the interpretation of financial history contained in these six chapters is the opinion of which the seventh is the reasoned expression: that "it would be premature and unwise to link *any* currency to gold at the present time, when the value of gold is utterly out of equilibrium and is destined probably for several years to be the plaything of contending forces which no one can foresee or measure." The monetary policy of countries which are off gold should, meanwhile, until stabilisation becomes practicable, aim at the "maintenance of the currency unit at that value which will just secure equilibrium between prices and wages." "Here is the key to the unemployment problem." Mr. Hawtrey maintains that objections to a postponement of stabilisation on the ground of the need for stabilising the foreign exchanges originate chiefly in a misapprehension of the conditions that have led to inflation in the past, and that history shows that "inconvertible paper currencies under normal conditions, when they are exposed to no such emergencies" as an "overwhelming financial strain due to war, revolution or economic catastrophe" "may go on, not merely for years, but for generations, without serious disturbances of their values," and "may sometimes be actually *more* stable than a metallic currency." "At the present moment it is true to say that every paper currency in the world that has not been tied to gold, has, over the past three years, changed less in purchasing power than the gold." The practical difficulty is admitted to lie in the correct estimation of the price level. Mr. Hawtrey would use the Wholesale Price Index number, modified by an allowance for any important changes in the prices of particular commodities which are traceable to non-monetary causes. This is the monetary policy advocated for the near future, but by no means as a permanency. Mr. Hawtrey still holds to all the objections advanced in his first chapter against Mr. Keynes's proposal, made in 1923, for the adoption of a regulated currency without a metallic basis. "By the time industry in the remaining gold standard countries is once again fully employed we should be prepared to consider taking the step" of a return to gold, but not "unless we would be sure of some degree of international co-operation." This

introduces a discussion of some fifteen pages on the Report of the Gold Delegation of the League of Nations, and a consideration of what might be achieved, in default of a more general agreement, by the joint action of Great Britain and the United States. The last paragraphs touch on the question of parity and the considerations which should influence the choice of level.

The index is full, but might have been made considerably more helpful than it is. C. T.

9.—*The Portuguese Bank Note Case: the story and solution of a financial perplexity.* By Sir Cecil H. Kisch, K.C.I.E. London: Macmillan, 1932. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. ix + 284 pp. 10s. 6d.

The first part of this book consists of a very good story remarkably well told. The case has become famous. A gang of conspirators, by means of forged letters and documents and other wiles, induced Messrs. Waterlow in 1925 to print notes to the value of 290,000,000 escudos from the genuine plates used to print Bank of Portugal notes, and notes to the value of some 100,000,000 escudos (more than £1,000,000) were actually put into circulation. On the discovery of the fraud, the Bank of Portugal (acting with the approval of the Portuguese Government) withdrew all the notes, good or bad, of the design that had been forged, and paid the holders in full with good notes.

Sir Cecil Kisch narrates the events with force and clarity, and so leads up to a critical examination of the legal proceedings which followed. The Bank sued Messrs. Waterlow for damages and carried the case through the Court of Appeal to the House of Lords. There was much difference of opinion among the judges, chiefly on two points:

(1) Granted that the fraudulent notes had in the first instance to be redeemed along with the good ones of identical design, ought not the Bank to have ceased redeeming the former as soon as a method was discovered of distinguishing them?

(2) When a bank of issue which was not bound to convert its notes into gold issued good notes in exchange for bad ones, did it suffer any other loss than the cost of paper and printing?

As to the former, the final decision by the House of Lords was that the Bank was right to go on redeeming the fraudulent notes so long as it had the authority of the Government to do so, although within a few days a method was discovered by which some at any rate of them could have been distinguished.

It is in the second point that Sir Cecil Kisch finds his principal subject of discussion. Counsel for the Bank argued that the issue of good notes in exchange for the fraudulent notes "was equivalent to an issue of notes without receipt of value, and that for the purpose of compensating the Bank for loss of value it should be indemnified on the basis of the value of the notes in the outside market" (p. 195). And that was what the final decision of the House of Lords allowed. Damages were assessed at the face value of the notes converted

into sterling at the rate prevailing in 1925, subject to the deduction of the value of securities, etc., recovered from the criminals.

And how could it be otherwise? Sir Cecil Kisch devotes much ingenuity to unsettling our minds on a matter that should be obvious. When the criminals issued the illicit notes, "they added to the stock of money in the country, and the true problem is to evaluate the financial effect of this expansion on the Bank which adopted or crystallized it, when it permitted the extra circulation to continue by the substitution of legal for illicit notes."

If the effect of the redemption of 100,000,000 escudos of illicit notes was simply to increase the circulation by 100,000,000 escudos, the assets of the Bank would remain undiminished, and it would lose nothing except in so far as the value of those assets might be reduced by a consequent depreciation of the escudo. If it be objected that the depreciation might be expected practically to nullify the advantage of the extension of circulation in terms of gold or of real wealth, the answer is that the profits of the Bank were derived not from its entire note issue, but from its "commercial" circulation, limited to about one-ninth of the whole, which was backed by commercial bills, the remaining eight-ninths being backed by advances to the Government at a nominal rate of interest. The commercial circulation was preserved undiminished, and was indeed actually extended after the episode of the forgery.

But to suppose that these circumstances impaired in any way the Bank's claim against Messrs. Waterlow would be a complete mistake. In so far as the conditions of the Bank's circulation were amended in its favour, that was the act of the Government (which at the time had the power of legislating by decree). The Government indemnified the Bank against the loss, as it was almost bound to do, for no country can afford to leave its central bank palpably insolvent. But that was a matter between the Government and the Bank. Possibly the Government, having assumed the liability for the loss, ought to have taken the place of the Bank as plaintiff, but, however that may be, it makes no difference to the validity of the claim.

The Government, if it was to indemnify the Bank, had to provide resources to the amount of 100,000,000 escudos. It had the choice of providing them by taxation, or by the flotation of a loan, or by inflation of the currency. But whichever course were followed the money would be raised at the expense of the Portuguese people, and it was not for a court of law to enquire through what channel the Government chose to raise it.

Sir Cecil Kisch argues that the money was in fact raised by inflation. The note issue was extended, and the gold value of the currency was reduced two or three years later by one-ninth. But these measures cannot be linked with the indemnification of the Bank. Inflation in Portugal had culminated in 1924, and in 1925 the currency had recovered and was being held provisionally at a fixed rate of exchange. A reserve of foreign exchange was being accumulated, the Government assuming the exchange risk. The Government had ceased to rely on crude inflationary finance. In July 1926 the maximum limit on the note issue was extended, not only by 100,000,000

to regularize the redemption of the illicit notes, but by a further 100,000,000. But that did not imply inflation. When a currency is stabilized after inflation at or near its existing value, it is invariably found that an increase in the note issue is required to make good the shortage previously caused by a flight from the currency. In 1925 this process was at work in Portugal and was enabling the Bank to extend its commercial issue, which had fallen far below the permissible limit. The appearance of the forged notes in that year interrupted the extension.

In 1928 the rate of exchange was raised from 96 escudos to the pound to 108. But there is no ground for supposing that this was done on any other ground than the public welfare. The Government was not in such a state of embarrassment as to resort to this expedient to raise 100,000,000 escudos. And after our own experience of the operation of a gold parity established in 1925 during the ensuing years of falling prices, it is not for an English economist to say that it was unwise.

"If State policy dictated the assumed course of progressive depreciation," says Sir Cecil Kisch (p. 219), "then the State lost at the utmost the opportunity of raising £100 million by the method of inflation, and . . . must have had recourse, if its exigencies so required, to taxation in other forms. The Bank in that case lost nothing." Why "at the utmost"? Why a maximum? Why not equally a minimum? What the State lost was what the Bank would have lost if it had been saddled with the illicit notes, neither more nor less.

R. G. H.

10.—*British Public Expenditure, 1921-31.* By Joseph Sykes, M.A., M.Com. London: P. S. King. 1933. 8½" × 5½". xii + 388 pp. 15s.

Mr. Sykes sets out to record the more important changes in British public expenditure during the decade 1921-31, and to trace their more obvious economic and social consequences. His main conclusions are that the lessening of social and individual inequality has had profound effects of a highly favourable character, while no dire consequences have ensued for the national economy as a whole. He suggests, however, the necessity for reduced expenditure in various directions, including the revision of the social services and pensions in the light of the increasing value of money.

Particular interest attaches to his attempts to measure the changing incidence of taxes and expenditure. He calculates that "the statistics of national and local expenditure for the ten-year official financial period 1921-31 show a net national expenditure amounting to £8,048m., and a net local expenditure of about £1,740m.—giving a total public expenditure of £9,788m., or an annual average of £979m. Precise statistics of the national income during the period are not available, but this," he says, "may be approximated at an annual average figure of £4,000m. It follows that the proportion of the national income appropriated for public expenditure is in the neighbourhood of 24·5 per cent. By contrast, since net expenditure in 1913 amounted to £170m. for national

purposes and £79m. for local purposes—a total of £249m.—and the national income may be put approximately at £2,300m., the proportion of the national income taken for public uses was under 11 per cent.” (p. ix).

A glance at the calculations will indicate the difficulties in the way of obtaining figures comparable with 1913–14, difficulties which are substantially increased when the quest is for an elusive average over a period so changeable as the decade 1921–31. It appears that the 1913–14 total of £249m. is obtained by adding the “net national expenditure” of Great Britain and Ireland (£170m.) to the “net local expenditure” of Great Britain only (£79m.), while the decade total of £9,788m. is obtained by adding the net local expenditure of Great Britain only (£1,740m.) to the net national expenditure of the United Kingdom (£8,048m.), a financial area which changed in both size and character during the decade. The national expenditure figures are based throughout on those of the May Report, the 1930–31 figures of which are, incidentally, estimates.

The author summarises his analysis of national taxation and expenditure in the following “rough table of percentage benefits and taxation” (p. 339).

Percentage Allocation of Taxation and Benefits.

	Benefits.		Taxation.	
	1913–14.	1921–31.	1913–14.	1921–31.
Richer	49	51·5	63·2	70·4
Poorer	51	48·5	36·8	29·6
	100·0	100·0	100·0	100·0

When one looks behind the striking simplicity of this table, numerous points become apparent, amongst which may be mentioned (1) the terms Richer and Poorer are “used to distinguish between that section of the adult community which is in receipt of income in the shape of wages or other income which does not exceed the highest level reached by wages income, and that section of the adult community which is in receipt of income exceeding the highest level reached by wages income. Although there was a certain overlap in the period in the case of some Poorer incomes which, for a variety of reasons, actually paid income-tax, this corresponds broadly to the division between persons not subject to direct taxation and those who were subject to direct taxation” (pp. 120–1). The elasticity of this classification clearly facilitates the task of allocation but materially affects the validity of the resulting figures.

(2) In allocating benefits, national expenditure is classified under three heads (a) that in the interest of the Richer; (b) that in the interest of the Poorer; and (c) that in the general interest. Class (a) is estimated at 38 per cent. in 1921–31 compared with 16 per cent. in 1913–14. Of the £3,055m. included under this head for

the decade, £2,930m. is due to "Debt Services ($\frac{1}{5}$ share)." Debt Services obviously offer a difficult problem, but to show four-fifths as benefiting the Richer, and thus more than outweighing the whole national expenditure on the Poorer, will not pass unchallenged. Class (b) includes Pensions, Education, Insurance, Debt Services (one-fifth share), Housing, etc., and is estimated at £2,795m., or 35 per cent., in 1921-31 compared with 18 per cent. in 1913-14. Class (c), which includes £1,227m. for Defence Services, totals £2,198m., or roughly 27 per cent. in 1921-31 compared with 66 per cent. in 1913-14. The author, merely declaring that as the benefits derived are general, the expenditures in this class "are therefore applicable to both categories equally," thereupon allocates one-half of the percentages (i.e., 13.5 for 1921-31 and 33.0 for 1913-14) to the Richer and the same to the Poorer, a proceeding which calls for further explanation, particularly in view of the relative numbers of the two classes, and the amounts involved.

(3) In taxation, problems of incidence—and of classification—are settled by allocating the whole of direct and one-fifth of indirect taxation to the Richer, and the remaining four-fifths of indirect to the Poorer.

In the subsequent estimates and conclusions, Mr. Sykes returns to more solid ground, and comments freely on the detailed figures he has collected. Public expenditure has been relatively neglected by economists, but Mr. Sykes, in his lengthy and detailed study, has done something to remedy this, and he is to be congratulated on his courage in tackling so arduous and formidable a task.

C. O. G.

11.—*Taxation of Income in India*. By V. K. R. V. Rao, M.A., Assistant Professor of Economics and History, Wilson College, Bombay. Calcutta and London: Longmans. 1931. 8 $\frac{1}{4}$ " \times 5 $\frac{1}{2}$ "; xvi + 327 pp. Rs. 6, or 10s. 6d. in England.

The first book by an economist on the Indian income tax was published some fifteen years ago by Dr. Pagar. Since that there have appeared Professor Bannerjea's *History of Indian Taxation* and Mr. Niyoji's *Evolution of the Indian Income Tax*; but the volume under review is the first comprehensive work on the Indian income tax, embracing its history, a description of the present law and administration, a discussion of the economic and fiscal problems which present themselves, and the case for certain reforms. The book is written clearly and in scientific vein, without political bias. It is a valuable contribution to the study of the income tax, even if the practicability and justification of some of the author's proposed reforms may be questioned.

The first three chapters treat the history of the tax in well defined periods. The first, 1860 to 1886, was experimental, the scheme of direct taxation being frequently completely altered in character. The second period, commencing with the Act of 1886, placed the tax and its administration on a permanent basis, with few changes, so that the people became accustomed to it; whilst the third period, from 1916 on, saw a number of changes, due at first to the exigencies

of war finance, and later to the necessity for legislation following judicial decisions and for tightening up the collection of the tax. There is a useful description of the tax as now levied, including the plan of graduation according to income, and the assessment methods, with references to law cases and the official Income Tax Manual.

Chapter IV begins the discussion of the tax from the economist's point of view—the character of the income taxed, and the application of the general principles governing income tax to Indian conditions. Of two chapters on the scope of the tax the first explains and criticises the exemption of agricultural incomes—a peculiar feature of the Indian system. It was the Act of 1886 which established this exemption; and the grounds on which it is maintained are the avoidance of double taxation, land revenue being considered as a tax, and to some extent the difficulty of the pledge given to owners of permanently settled lands that the income from their lands would never be subjected to any increase of taxation. In relation to the general exemption of agricultural incomes the old controversy as to whether land revenue is a rent or a tax crops up again. In the permanently settled districts of the provinces of Bengal, Bihar and Madras it has the character of a perpetual quit rent paid for proprietary right in the land; but in other parts, although the *zamindar* (landlord) or *ryot* (peasant) holds from the Government only for cultivation, and at a revenue fixed for 20 or 30 years, the author holds, following the Taxation Enquiry Committee, that land revenue is a tax. He proceeds to assume that because it is a tax it must be a direct personal tax like income tax, and should therefore be graduated like the income tax. He makes two proposals: that landowners under permanent settlement should be taxed on the balance of income after deducting the land revenue they pay, and that holders under temporary settlement should pay only if their incomes exceed Rs. 30,000 per annum, and then only to the amount by which the tax to which they would be liable if the income were not agricultural exceeds the land revenue paid.

The author appears to have been too absorbed in the income tax to notice the similarity of the Indian land revenue to the land taxes of several other countries, and to realise the fundamental difference between taxes assessed on area cultivated and on a person's total income. No one acquainted with Indian conditions will doubt the justice and necessity of assessing agricultural incomes to income tax, but it is the net income (usually money rent) after deduction of land revenue which should be assessed, whether the settlement is permanent or temporary. The peasants would not be liable to income tax, their earnings being below the exemption limit, which is £150.

Other peculiar exemptions in the Indian system are described in the next chapter; and in the following chapter the author considers the case for personal allowances, which do not exist in the Indian income tax. Since marriage is the almost invariable custom in India he recommends allowances only for children. The super-tax is described, and so are three special features of the Indian

income tax, namely, the taxation of companies, of partnerships, and of Hindu joint families. Companies are obliged to deduct tax from dividends at the maximum rate, which can be reclaimed by shareholders, if not liable, as in England; but companies also pay a flat rate of super tax at $6\frac{1}{4}$ per cent. on their profits, if these exceed Rs. 50,000, a discrimination against this form of business organisation against which the mercantile community continually protests as an unwarranted relic of the war period. The Hindu undivided family consists of a large number of relatives of the second and third generations usually living together in one large house and entitled to maintenance and shares in the family income. This aggregate of families (from the European point of view) is assessed as a whole according to a special progressive scale; but the author points out several injustices.

The comparisons of the Indian tax with the income tax systems of other countries are very interesting, and Professor Rao has given two diagrams showing at a glance the percentage of income absorbed by the tax for each income in India and for various other countries. The problem of double taxation is considered; and a number of administrative problems are reviewed, though this section is not so thorough as might be. Finally there is a chapter on the economic condition of the people as reflected in the income tax statistics, and a summary of conclusions in the book as a whole, followed by a series of valuable appendices giving comprehensive administrative and revenue statistics and useful technical information.

Professor Rao may be congratulated on having produced a book of great interest to every student of public finance, and one which should be consulted by foreigners anxious to study the Indian tax system. It has an added importance in view of the declared intention of the Indian Government to undertake a complete revision of the Indian income tax, as soon as the pending constitutional reforms are brought into force, in order to remedy certain defects and injustices of the tax which have been accentuated by the fall of the price level and by the substantial increase in the rates of the tax for each grade of income necessitated by the financial situation in 1931.

H. S. J.

12.—*International Trade*. By P. Barrett Whale. Home University Library. London: Thornton Butterworth, Ltd., 1932. $6\frac{3}{4}'' \times 4\frac{1}{2}''$. 254 pp. 2s. 6d. net.

Within the compass of this relatively small book, Mr. Whale has packed a tremendous amount of argument and explanation. Following a short introduction, Chapter I explains, necessarily in an elementary way, the technique of international payments. This is followed by a chapter on foreign exchange rates, and the balance of international payments is discussed with a certain amount of detail. The various causes of such payments are clearly classified and in the course of a few pages the Balance of Payments theory is defined with respect to exchange rates and the gold standard. Professor Cassel's Purchasing Power Parity theory is described and criticized until it is presented in a form that "is certainly true, and can, as Cassel has

shown, be of value." But in order to give a complete theory the various changes which disturb international price equilibrium are considered. The section devoted to disequilibrium in the balance of payments is followed by the theory of comparative costs and international division of labour. Chapters VI and VII, dealing respectively with the protection and regulation of international trade and with commercial treaties and tariff bargaining, are particularly topical. Arguments in favour of free trade and protection are clearly stated and "dumping," carefully distinguished from "exchange dumping," is discussed at length. A useful section is devoted to methods of control whereby the balance of payments may be corrected when currency depreciation fails to provide the necessary corrective influence.

A short note on quota schemes is of especial interest. Mr. Whale concludes that the system on which the British Wheat Act is based is, although complicated, the best method for maintaining wheat production, and, provided the desirable limits of output can be economically determined, may serve for other industries as well. Commercial treaties and tariff bargaining are considered at comparative length and with considerable success. Prospects of international trade are discussed in the last chapter. A useful bibliography and an index complete the work.

This book gives, within short compass, an excellent survey of the theory of international trade. Its intelligent understanding will, however, demand more serious application of mind and thought than is required by many of its companion volumes in this excellent series.

R. F. G.

13—*International Wage Comparisons*. Manchester University Press, 1932. 9½" × 6". 262 pp. 10s. 6d.

The Social Science Research Council of New York convened two Conferences at Geneva in January 1929, and in May 1930 respectively, to consider the question of international wages comparisons, and the above volume arose out of the resolutions and recommendations of the Conferences. Representatives from six countries were present: Canada, France, Germany, Italy, the United Kingdom and the United States, in addition to representatives from the International Labour Office. The volume contains the recommendations of committees on Wage Index-numbers (as to choice of data, localities, period, etc.) and on Cost of Living Indices, and also reports from each of the countries represented, together with three memoranda presented by the International Labour Office. The national reports give the main sources of the material for wages statistics in each country together with a description of the nature of the material, i.e. rates, earnings, etc. The memoranda from the International Labour Office relate to International comparisons of money wages and real wages, and to index-numbers of wages. The national reports are of great value, as, though brief, we are enabled to see what is the nature of the material available, and the comment, although of the smallest, gives a fair idea of its value. At the end of the volume is a report by Mr. John Jewkes, who gives selected

tables, necessarily much compressed, of index-numbers, of rates of wages, earnings, prices and cost of living in the six countries, together with, where possible, an account of the methods of compilation and brief critical comments. In no other publication that we know of is so much valuable information brought together relating to these subjects, and the time and labour spent on the preparation of the volume must have been very considerable.

W. A. B.

14.—*The Theory of Wages*. By J. R. Hicks, M.A., B.Litt., Lecturer in Economics, London School of Economics. London: Macmillan, 1932. 8 $\frac{3}{4}$ " \times 5 $\frac{3}{4}$ ". xiv + 247 pp. 8s. 6d.

Mr. Hicks sets out to give "a restatement of the theory of wages in a form which shall be reasonably abreast of modern economic knowledge." He begins by subjecting Marshall's doctrine that "the earnings of a worker tend to be equal to the net product of his work"—the principle of Marginal Productivity—to a close analysis and finds that it holds good in a free market where all the factors are in a state of equilibrium. In the following five chapters he proceeds from this highly abstract conception to the normal labour market, considering in Chapters III to V a free labour market in which there is a tendency to an expansion or a contraction of labour, where men differ in efficiency, where there is unemployment even in expanding trade, and where there is competition between persons and groups and trades. Thus he attempts to ascertain the degree of indeterminateness imported into the principle by the actualities of life, and finds that the forces which worked in an equilibrium market still operate in a normal market for, among other reasons, the great majority of the men in a trade are of "average" ability. In Chapter V there is a useful discussion of the effects of changes in wages and hours on efficiency, from which it emerges that rises in wages come generally from the initiative of workpeople, but that a reduction in hours must come from the employers or be imposed from outside. The next chapter is of grave importance, for it treats of the effect of an increase of the supply of one factor of production on the total output, on the share of that factor, and on the share of the other factors. "Increasing capital," Mr. Hicks says, "accompanied by stagnant invention may very well raise labour's relative share in the (National) Dividend; but increasing capital, with active invention, is very likely to do the contrary. And since the activity of invention is definitely favourable to the growth of the Dividend—and with few exceptions also favourable to growth in the real income of labour—it is highly probable that periods of most rapidly rising real wages will also be periods of a falling relative share to labour. It is clear that we have here a divergence of no small significance" (p. 130).

The second part of the book deals with the regulation of wages by trade unions and legislation. The length of a trade dispute depends on the difference to the employer between the cost of the increased wage and the absolute loss during the strike period, modified by his desire to retain the good-will of his employees.

The power of the trade unions to resist cuts in pay has been strengthened in the post-war period by the system of unemployment insurance. "If there are not sufficient uncontrolled industries to absorb the men who cannot get employment in the controlled industries—or absorb them at a real wage above starvation level—then the unemployment which results is not temporary. It must go on, until the long-run economic forces which determine competitive wage-levels—invention, the accumulation of capital, and, in an open community, the direction of foreign trade—produce such a change in the wages which would have been paid in a competitive market as to enable the unemployed to be absorbed. That is to say, the unemployment must go on until the artificial wages are relaxed, or until competitive wages have risen to the artificial level" (pp. 180–81). We have a new "Iron Law"—that, if wages are artificially raised above the level at which competition would have put them, then in a closed community there will be a shift from industries employing much labour relative to capital to those employing much capital relative to labour; there will be a wastage of capital, a diminution of savings, and a tendency to substitute machinery for labour. Unemployment must increase, alike in a single industry and in industry as a whole. In an open community engaging in foreign trade, the competition of countries where wage-control is less will increase unemployment in the exporting industries, especially in the heavy industries, though these will be helped by the shift from the less to the more capitalized forms of production; the rate of saving will decrease and the wastage of capital will increase. The capitalist has two lines of defence against that wage-regulation which diminishes his profits. The first is evasion, "and on the long road from ancient smuggler to modern industrialist, the entrepreneur has learned more tricks than are easily reckoned with" (p. 229). The second is "the changing of methods to the advantage of capital and the disadvantage of labour" (*loc. cit.*), and in the long run the entrepreneur can withdraw his capital from the industry or consume it in maintaining his own consumption. There is no hope in socialism or in stabilization of the price level; "it is only from increased efficiency that we can look for a moderating effect on unemployment" (p. 211).

This is a powerful but a gloomy book and the author has great powers of analysis which he employs relentlessly. His conclusions will be displeasing to many, perhaps to most, people, but they are arrived at dispassionately. One hesitates to accept them all; one feels that the examination is not complete, one shrinks from the notion that progress is dependent on an economic syllogism. There must be a law of increasing returns in the application of ideas to economic development and Mr. Hicks has made it imperative for us to find it. .

H. W. M.

15.—*Agricultural Credit*. By Alexander J. Boyazoglu, D.Sc. London: P. S. King & Son, Ltd., 1932. 8½" × 6". xxxiv + 267 pp. 15s.

It is seldom that we receive works on agricultural economics from

Greece, and books dealing with the theoretical aspects of agricultural credit are nearly as rare. "

This book opens with an historical review of the subject and an examination of the special place of agricultural credit as an independent aspect of credit as a whole. This naturally leads on to the subject of capital in agriculture, dealt with in brief paragraphs which seem, at times, too brief for the matters discussed. Post-war conditions and their effect on agricultural capital are well described, although in dealing with the organization and the forms of agricultural credit the author gives rather slight consideration to the part played by the banks. The nature of the various classes of security required is classified, and similar sectional treatment disposes of the reasons why farmers want credit. One of the most interesting passages in the book concerns the ideal system of organization for agricultural credit. This question is considered almost entirely in its theoretical aspect, and perhaps too little is said of the need for bearing in mind the social and economic background of the agricultural community concerned.

The last chapter deals with the international aspects of agricultural credit, and the difficulties to be encountered by an international system are clearly set out.

On the whole, the book gives an admirable, if at times elementary, outline of the subject. The presentation of the material, however, leaves much to be desired in so far as the division of the chapters into sections and subsections gives almost every page at least one paragraph heading, and often more; in the chapter on "Usury in Rural Districts" there are twelve sub-headings in less than five pages. There are countless footnotes, a bibliography, and an index. No reference, however, is made to our own Agricultural Mortgage Corporation, nor to the excellent Report on Agricultural Credit prepared by the Ministry of Agriculture in 1927. R. F. G.

16.—*The Cost of the War to Russia*. By Stanislas Kohn and Baron A. F. Meyendorff, D.C.L. London: Humphrey Milford, Oxford University Press, 1932. Published for The Carnegie Endowment for International Peace. 9 $\frac{3}{4}$ " \times 6 $\frac{3}{4}$ ". xi + 219 pp. 19s.

This book comprises two distinct subjects, (a) the vital statistics of European Russia during the war years 1914-17, by Professor Kohn, and (b) the social cost of the War, by Baron Meyendorff. It is not surprising to read in the opening paragraphs that vital statistics in Russia have never been accurately collected or regularly published; the last official volume of the old régime appeared in 1916 and referred to the year 1910. The data used by Professor Kohn have been mainly taken from the Reports of a Commission established in 1920 to investigate the effect "of the War of 1914-20" on public health. In the opening chapter, the number of men called up for service is investigated and arguments are developed concerning the effect of the mobilizations on the sex-composition of the population. The influence of civil and war prisoners and of refugees is also discussed. Before the War, the marriage rate in Russia was relatively high, although it declined between 1894-97

and 1909-13 from 9.1 to 8.1. Geographically, the rate diminished from east to west. The absolute number of marriages, however, in 1917 was less than two-thirds of the 1913 figure. Incidentally, during the period 1913-16 the average age at which males married increased considerably, whereas no important change occurred in the ages of the females. The birth rate in pre-War Russia was also relatively high, being 44.3 in the decade ending 1913; in the eastern provinces the rate averaged over 50 and diminished to a minimum of "under 38" in the west. The number of births in the seven provinces (including that of Moscow) for which figures are available declined by nearly 50 per cent. between 1913 and 1917. Illegitimate births increased in urban and rural districts alike during the War years, especially after 1915. The death-rate was already declining well before 1914 and continued to do so during the War. On balance, the population in the provinces for which adequate figures are available continued to increase, although at a decelerated rate, until 1917, when an actual decrease occurred (this decrease was evident in the capitals in 1916). In European Russia as a whole the natural growth of the population is estimated to have increased by 1,300,000 at the most during the three years ended 1917. A discussion on the War losses of Russia and nine statistical appendices complete Professor Kohn's contribution.

Baron Meyendorff's share of this book opens by considering the loss of territory and population of European Russia. The unfavourable effects of the War upon Russian agriculture, however, were to some extent counteracted by increased efficiency on the part of those remaining on the land, compulsory temperance and the labour provided by prisoners of war. After a description of the fortunes of agriculture during the first three War years, a brief review is given of the industrial situation, the record of which seems to be cheers for the Tsar on the one hand and an incessant series of strikes on the other. Whereas agriculture lost the large-scale producer and so gave way almost exclusively to peasant farming, the contrary movement characterized industry, which tended to assume the mass production features of highly industrialized countries. The economic and political causes of acute labour difficulties are clearly and briefly related, but one feels that this phase of Russian history requires a whole book in itself. The last (and shortest) chapter in the book deals with the effects of the War upon investments. Between March and October 1917, capital alternated between resistance and retreat and finally decided to take the latter course when it was too late to do so. R. F. G.

17.—*Japanese in the United States.* By Yamato Ichihashi. London: Humphrey Milford, Oxford University Press, 1932. 8" x 5½". vii + 426 pp. 22s. 6d. net.

Professor Ichihashi submitted a thesis to Harvard University in 1914 on the subject of Japanese immigration into the United States and has recently elaborated and completed the study. The result is a book packed with detailed information. The author feels that the actual facts of Japanese immigration into the States are

not appreciated as accurately as they ought to be, and that the problems arising from this movement of population have been denied their proper perspective. The information in this book is intended to correct any false impressions that may exist.

The first four chapters discuss the coming of the Japanese into the United States and suggest that Professor Ichihashi has spared no pains in tracking down every one of his fellow-countrymen who has ventured to land on American soil. In 1870 (sixteen years after the Japanese were allowed to leave Japan) there were only 55 Japanese in the United States; sixty years later they numbered 138,834, of whom approximately 30,000 were born in America.

Chapters V-XIV concern the character and the cultural aspects of the Japanese in the States. Of the immigrants during the 20 years ended 1908, merchants, labourers and students each accounted for 21 per cent., while artisans represented only 4 per cent. The inadequacy of the data as to the illiteracy of the Japanese on which much quoted figures are frequently based is well emphasized. The immigrants occupied in domestic service, city trades, miscellaneous trades and agriculture, and their residence, classified by States, are described in statistical detail. Of outstanding interest is the chapter devoted to the cultural background of Japanese immigrants, in which an excellent and well-founded argument is adduced to show that the attitude of the immigrants has been to assimilate themselves to the best of their ability and as rapidly as possible.

Chapters XV-XIX concern anti-Japanese agitation. The efforts of the State of California just before the War to discriminate against the freedom of the Japanese immigrant, especially with regard to his occupation of land, are related with a vigour worthy of them, and the Exclusion Law of 1924 is given detailed consideration. The last natural subdivision of the book surveys the "second generation" problems, and after dealing with the statistical aspects, the physical and mental characteristics of the American-born Japanese are described. The most serious problem of the "second-generation" Japanese is that of vocational adjustment and, so far, American employers have refused to employ American-born Japanese outside the occupations in which alien Japanese have been allowed to enter. Statistical appendices and an adequate index complete this excellently written and most interesting book. R. F. G.

18.—*Essays in Biography*. By John Maynard Keynes. London: Macmillan, 1933. 8" x 5½". x + 318 pp. 7s. 6d.

This book consists of two parts, "sketches of politicians" and "lives of economists," and the several essays, with the exception of those on Mr. Lloyd George and Robert Malthus, have been published previously in various periodicals. With the first part we have nothing to do here except to say that it exhibits to the full Mr. Keynes's powers of vivid and ironic portraiture. The second part deals mainly with Malthus, Marshall, and Edgeworth, with some brief sketches of Frank Ramsey, a young Marcellus of mathematical philosophy, who died at the untimely age of twenty-six.

We have already made acquaintance with the memorial reviews of Marshall and Edgeworth when they appeared in the *Economic Journal*.

Thomas Robert Malthus was to his pamphleteering contemporaries a "cruel and vicious monster." To the young student of economics he is the author of a theory of population which has to be "got up," and, if the enquirer proceeds further, he discovers a relationship with Ricardo and some connection with the "iron law of wages"—altogether a repellent figure. The Royal Statistical Society, however, hails him as one of its founders, though he did not live to see it through its infancy. Mr. Keynes brings him to life as a kindly, loyal, and affectionate man, beloved by his friends, and successful in struggling against physical disabilities. His best-known economic works are, of course, the essays on "Population" and "Rent" and his "Principles of Political Economy," but Mr. Keynes attaches more importance to his correspondence with Ricardo. Ricardo's letters have already been published and we are soon to have the lately-discovered letters of Malthus. "In economic discussions," says Mr. Keynes, "Ricardo was the abstract and *a priori* theorist, Malthus the inductive and intuitive investigator who hated to stray too far from what he could test by reference to the facts and his own intuitions. . . . Ricardo is investigating the theory of the *distribution* of the product in conditions of equilibrium, and Malthus is concerned" (in the correspondence) "with what determines the *volume* of output day by day in the real world. Malthus is dealing with the monetary economy in which we happen to live; Ricardo with the abstraction of a neutral money economy. . . . One cannot rise from a perusal of this correspondence without a feeling that the almost total obliteration of Malthus's line of approach and the complete domination of Ricardo's for a period of a hundred years has been a disaster to the progress of economics. Time after time in these letters Malthus is talking plain sense, the force of which Ricardo with his head in the clouds wholly fails to comprehend. . . . If only Malthus, instead of Ricardo, had been the parent stem from which nineteenth-century economics proceeded, what a much wiser and richer place the world would be to-day!" Mr. Keynes's enthusiasm makes one thirst for the complete correspondence.

In the course of a lifetime one has many regrets, and not to have studied under Alfred Marshall is one of them. The reverence with which his old pupils always regarded him shows how great was the inspiration he communicated, much greater than the instruction they derived, and so, as Mr. Keynes says, "it is through his pupils, even more than his writings, that Marshall is the Father of Economic Science as it exists in England to-day." "Professor Planck, of Berlin, the famous originator of the Quantum Theory," says Mr. Keynes in a foot-note which deserves a more honourable place, "once remarked to me that in early life he had thought of studying economics, but had found it too difficult! Professor Planck could easily master the whole corpus of mathematical economics in a few days. He did not mean that! But the amalgam of logic and intuition and the wide knowledge of facts, most of which are

not precise, which is required for economic interpretation in its highest form is, quite truly, overwhelmingly difficult for those whose gift mainly consists in the power to imagine and pursue to their furthest points the implications and prior conditions of comparatively simple facts which are known with a high degree of precision." Marshall's mental equipment was precisely that "amalgam of logic and intuition and wide knowledge of facts." His interest in the working classes brought him into economics, and in order to study his problems he spent years—from 1875 to 1890—mainly in research. To quote a document he himself wrote: "He set himself to get into closer contact with practical business and with the life of the working classes. On the one side he aimed at learning the broad features of the technique of every chief industry; and on the other he sought the society of trade unionists, co-operators, and other working-class leaders." Such was the training of the theorist, and well would it be if every new economist did the same! We might then have less of the addiction to mathematical analysis which he deprecated. Another piece of advice lies in his words: "While attributing high and transcendent universality to the central scheme of economic reasoning, I do not assign any universality to economic dogmas. It is not a body of concrete truth, but an engine for the discovery of concrete truth." In some specially useful pages Mr. Keynes assembles a statement of Marshall's contributions to monetary theory, but all must regret with him that Marshall did not compose an authoritative exposition of his views while he was in his prime. Altogether, Mr. Keynes's essay is a noble tribute to his master—to the Master.

Edgeworth was one of ourselves, we admired his handling of index-numbers and we listened in uncomprehending awe when he discoursed on the "generalized law of error." He attacked his ethical and economic problems like a Spanish grandee, with a lofty disdain for the material results and with an eye solely for the dragons he was to slay and the maidens he was to rescue. If we did not recognize the beauty of the maidens or the frightfulness of the monsters, we acknowledged that that was due to our blindness. To most people, he was best known as editor for so many years of the *Économic Journal*, and there is no contributor, even the least important, who has not had to acknowledge many kindnesses received at his hands. The present writer recalls a gracious and fascinating personality, courteous, self-effacing, eliciting the best points of his interlocutor, hospitable, and with a quaint humour as in pressing on his guest the audit ale of his College with warnings of its potency.

H. W. M.

19.—Other New Publications.*

Agarwala (R. D.). Sugar Industry and Labour in the United Provinces. With a foreword by R. C. Srivastava. Allahabad: Leader Press [1933]. 9½" × 6"; xii + 158 pp. Rs. 3.8.

[The three million acres of land under sugar-cane cultivation in India (more than half of which are in the United Provinces) form one-quarter of the

* See also "Additions to Library," p. 539 *et seq.*

total acreage of sugar-cane in the world. Yet India imports a considerable amount of foreign sugar. The author attributes this to the low standard of production. Irrigation, agricultural, and transport facilities are unsatisfactory, the business is in the hands of ignorant and conservative cultivators, a large quantity of sugar is manufactured primitively and uneconomically, and of the few modern cane factories some do not employ qualified technical experts or maintain proper laboratories. The author urges the necessity for the establishment of research and testing stations, more experimental farms, model sugar-refining stations, improved marketing facilities, and the development of co-operative methods. He maintains that when the necessary improvements have been made, India should be able to export in large quantities. The first part of the book gives a description of the industry and its defects, with suggestions for improvement, while the second deals with the conditions of labour. These the author finds satisfactory: there is no sweated labour, and no women are employed. He considers, however, that better educational and recreational opportunities would increase the efficiency of the workers. The book is mainly concerned with the economic aspect of the industry and scientific and technical details have been avoided as far as possible, but descriptions of plant and manufacturing operations are given, diagrams are included where necessary, and there are several appendices.]

Bachi (Roberto). Abitazioni e luoghi di lavoro nelle grandi città. Roma: Stab. Tip. del "Giornale d'Italia," 1932. 9 $\frac{1}{4}$ " \times 6 $\frac{1}{2}$ "; 44 pp.

[In this paper (originally published in *Economia*, Vol. X, No. 2), Dr. Bachi examines and compares the figures of daily movement between dwelling and work place in relation to five large cities, in order to ascertain whether they exhibit common characteristics, whether, if so, they may be ascribed to common causes, and whether a diagnosis of such causes may afford help in the solution of the traffic problems which are increasing in extent and complexity in all large towns. The cities selected are Hamburg, Genoa, London, Budapest, and Tokio, and most features of the daily migration appear to be common to all. The principal part of this migration consists of the daily journeyings from periphery to centre and back, which are obviously accounted for by the concentration of business in a central area or areas and the more advantageous living conditions to be obtained in outlying districts; but, in addition, a considerable daily movement in all these towns is between one outer district and another and is largely reciprocal, so that in theory much of it could be eliminated. But in these days of housing difficulties, rent restrictions, better wages, and cheap transport, nearness to the place of work is no longer a prime consideration to the employed person. The statistics from which the conclusions are drawn are set out in considerable detail. Among the facts brought to light is that in Budapest 2,648 men bicycle to work but only two women.]

Coyajee (Sir J. C.). The World Economic Depression: A Plea for Co-operation. Madras: Huxley Press, 1932. 9 $\frac{1}{2}$ " \times 6 $\frac{1}{2}$ "; iv + 96 pp. 1s. 6d.

["Only by a great co-operative effort on the world scale can this depression be overcome; and the first phase of such co-operation must be the creation of clarity of thought upon the subject." With this in mind the author "attempts to offer something like a clear presentation of the causal and remedial aspects of the . . . depression, and to analyse and appraise the numerous suggestions and theories advanced about it." The unregulated and constant extension of production and productive capacity, high tariff barriers, the disastrous effects of reparations, and a labour policy which makes for rigidity of wages, are, he asserts, the main tendencies to which the depression may be attributed, and are

the reverse of co-operative. He emphasizes the important effect of the business cycle and urges the necessity for eliminating this from our present economic system.]

Eggleston (F. W.). State Socialism in Victoria. London: P. S. King, 1932. $8\frac{1}{2}'' \times 5\frac{1}{2}''$; xv + 354 pp. 15s.

[A critical study of the origin and development of the public services administered by the State of Victoria and of the advantages and disadvantages to be observed in practice. The author has held several Ministerial appointments in the country. He was originally in favour of state ownership, but his experience in office convinced him that existing conditions in Victoria were not conducive to the successful management by the State of the majority of these services. The structure and kind of control of the more important public utility undertakings operated by either the State or the Municipal authorities are examined in detail, and the degree of success or failure in each case is estimated and as far as possible accounted for. Political interference is blamed for the serious financial losses of the railways and of many other public utility services. The author makes suggestions with respect to the future conduct of certain existing undertakings which cannot well be relinquished by the State. He advocates, among other things, an extension of the principle of personal responsibility, and the appointment of officials by municipalities or other public bodies instead of by the Government. As regards the remaining services, he suggests that the Closer Settlement schemes should be dropped and that the assets of the railways, tramways, and electric supply be sold or leased, preferably the latter, in view of present conditions. There are numerous statistical tables and graphs, copious bibliographical references, and an adequate index.]

Hough (Eleanor M.). The Co-operative Movement in India, Its relation to a sound national economy; with an introduction by the Rt. Hon. Sir Horace Plunkett, and a foreword by Professor Hiralal L. Kaji. London: P. S. King, 1932. $8\frac{1}{2}'' \times 5\frac{1}{2}''$; xxvii + 340 pp. 15s.

[The author begins this interesting study with a chapter on the present economic conditions in India and, after dealing briefly with the aims and development of co-operation in general, proceeds to a detailed analysis of the co-operative movement in India. This analysis is mainly concerned with co-operative credit in connection with agricultural development and may be described as a digest of legislation and of the reports and recommendations of the various commissions, committees, and other bodies on co-operative policy. There follows a review of the growth and present extent of co-operation and of what the author considers to be its principal handicaps, weaknesses, and achievements. The appendices greatly increase the value of the work. They include the text of the Co-operative Societies Act, 1912, tables of relevant statistics, a bibliography, and a very full list of references. The book will, therefore, serve as a very useful guide to the large and varied literature on the subject.]

Johns Hopkins University. Collected Papers from the Department of Biology and Public Health. Vol. VII. Baltimore, 1933. $9\frac{1}{2}'' \times 6\frac{1}{2}''$; 602 pp. (100 copies issued).

[The contents of this volume include the following papers by Dr. Raymond Pearl, the Head of the Department: the Influence of Density of Population upon Egg Production in *Drosophila melanogaster* (originally printed in the *Journal of Experimental Biology*), Tobias Venner and his *Via Recta*, Contraception and Fertility in 2,000 Women, Data on Fertility and Economic Status, An Explanatory Note regarding a more detailed

Classification of real Literature useful in the Study of Human Biology (all from *Human Biology*), and a Statistical Report on the Fourth Year's Operations of the Bureau for Contraceptive Advice (originally published by the Bureau); also A Table for Ascertaining Elapsed Time in Years and Decimals of a Year Between any Two Dates, by Raymond Pearl and John R. Miner (*Quarterly Bulletin of Milbank Memorial Fund*). Among other contents are: A Critique of Certain Earlier Work on the Inheritance of Duration of Life in Man, by I-chin Yuan (*Quarterly Review of Biology*), and Restrictions on Marriage in Eighteenth-Century Bavaria, by John R. Miner (*Human Biology*).]

Johnson (E. A. J.). *American Economic Thought in the 17th Century*. London: P. S. King, 1932. $8\frac{1}{2}" \times 5\frac{1}{2}"$; xi + 292 pp. 12s.

[The author has sought out, collated, and weighed the fragmentary references to economic questions in the literature of colonial days, in order to estimate the extent to which the economic philosophy of the early settlers influenced the later developments of American civilization. The economic ideas of the Puritans were based on ethical considerations, and the author shows that it proved impossible in practice to regulate economic life entirely in accordance with theoretical rules. He further points out that the divergence between American and European economic thought, which had become so wide by the middle of the 19th century, may be largely ascribed to the "crude economic ideas of a century of pioneers" which were, broadly speaking, those of the last phase of mediæval thought in Europe. The economic notions which emerge from the study are considered under separate headings, among which are the Control of Economic Activity; Ethics and Economics—the Vindication of Wealth; Trade Fettered and Free; Monetary Principles; Wages and Usury, and the Condemnation of Communism. A bibliography, a subject index, and an index of names are provided, and all sources of reference are given in footnotes.]

McCabe (David A.). *National Collective Bargaining in the Pottery Industry*. Johns Hopkins University Studies in Historical and Political Science. Extra Vols. New Series No. 16. Baltimore: Johns Hopkins Press, London: H. Milford, 1932. $8\frac{1}{4}" \times 5\frac{1}{4}"$; x + 449 pp. \$3.50.

[The system of national collective bargaining in the pottery industry exists, or used to exist, in the "general ware" (semi-porcelain and china) division, and in the "sanitary" division (it collapsed in the latter in 1922); and this study, the result of fourteen years' research into the subject, deals primarily with the workers within these two divisions who are, or have been, members of the National Brotherhood of Operative Potters. The Brotherhood was formed in 1890 and by 1899 had become the only important union in the industry. The book relates its history, organization, and negotiations with the United States Potters' Association in respect of wages and prices, methods of production, etc. The first important step towards national collective bargaining, which originated in a joint effort between employers and employees to increase the tariff, was made in 1897, and the first real national agreement between the Union and the Association in 1905. The author considers the rise and continuance of the national agreement system in the general ware division an exceptional experience in American industrial relations, and attributes it to four factors: the tariff bond, the localization of the industry, the wage uniformity tradition, and the mutual confidence between the officials of the two organizations. An interesting account of the operations and the separate occupations in the industry is contained in an introduction. An appendix gives a comparison of hourly earnings, by occupations, 1912-13 and 1925 (general ware), and a note on documentary sources.]

Royal Agricultural Society. *The Farmer's Guide to Agricultural Research in 1931.* London: John Murray, 1932. $8\frac{1}{2}'' \times 5\frac{1}{2}''$; ix + 141 pp. 1s.

[One section of this annual summary contains a review by Professor Ashby of the principal work done in Farm Economics in 1931. The organized studies in this subject carried on at agricultural colleges and research centres in Great Britain related in the main to questions of farm organization and the profitability of farming as tested by investigations of results obtained by groups of farms in various localities. Methods of marketing farm produce were the subject of important Reports by the Ministry of Agriculture. A bibliography of some of the principal publications issued during the year is appended to the Review.]

Stewart (*Annabel M.* and *Bryce M.*). *Statistical Procedure of Public Employment Offices. An Analysis of Practice in Various Countries and a Plan for standard Procedure in the United States made for the Committee on Governmental Labour Statistics of the American Statistical Association.* New York: Russell Sage Foundation, 1933. $9'' \times 6''$; 327 pp. \$2.50.

[As statistical records in employment offices, besides increasing the efficiency of the work and making for a better understanding of unemployment, indicate the ratio of supply to demand in the labour market, the importance of keeping comparable records cannot be too strongly emphasised. The authors have studied the methods used in the employment exchanges of Great Britain, Switzerland, Sweden, Canada, Germany, and France, as well as the United States. The knowledge thus gained and the probable expansion of the Federal and State public employment offices in the United States have prompted the drafting of a plan which "without unduly burdening the local officials will yield reports on the operations of the employment offices sufficient for almost any desired compilation or analysis." The main feature of this plan is the submission by local offices of a daily record of transactions to a central bureau for compilation and analysis. A suggested form of daily report classifies the information in four main headings and twenty-five subdivisions. Appendices contain a selected list of publications, statistical report forms in use in various countries, procedure in the New York State Division of Junior Placement, and wage rates secured by the employment services of Belgium and Canada. There is also an index.]

CURRENT NOTES.

On page 520 we give our usual table summarizing the overseas trade of the United Kingdom for the years ended May, 1932 and 1933. The excess of imports over exports of merchandise during the first five months of this year was £100.3 million, as compared with £120.5 million during the corresponding period of last year. For the whole year 1932 the adverse balance amounted to £287 million, and this has been reduced, for the latest period of twelve months, to £267 million. The import excess for May (£22.7 million) is the highest so far recorded this year, figures for January to April being 20.7, 16.7, 19.8 and 21.2 million £ respectively. There appears to be good ground for thinking that in the absence of any marked changes in world trade, resulting from a rise in prices of primary commodities or otherwise, the import excess for the whole year 1933 may be in the neighbourhood of £240 million.

The value of the total imports during May was £57,295,000, being an increase of £1,245,000 on the total for May, 1932. Imports of food, drink and tobacco were about the same in value in the two months, while imports of raw materials and of manufactured articles increased by £756,000 and £1,065,000 respectively. Re-exports were valued at £3,820,000, or £579,000 less than in May, 1932. There was also a small decline from £1,906,000 to £1,822,000 in the value of goods transhipped under bond. For the five months ended May, imports declined by £35,865,000 and re-exports by £5,214,000, while transshipments under bond increased by £799,000.

Retained imports of food, drink and tobacco during May were valued at £28,790,000, which was smaller by £489,000 than a year earlier. A large part of the decline was in living animals for food, but there was on the other hand a considerable increase in the value of the imports of meat. The latter increase was primarily in respect of bacon, in which there was a marked increase in price during the month, but the quantities of beef and of mutton and lamb imported were also more than in May, 1932. There was a substantial increase in the retained imports of wheat, though the value remained substantially unchanged, and for the first five months of the year the imports increased from 41.1 to 47.7 million cwts. or by 16 per cent. Imports of butter, eggs, tea and sugar were all greater than a year earlier. A very marked increase was shown in the quantity of unmanufactured tobacco imported, continuing the movement shown by the records of earlier months, there being an increase of 22 per cent. in the retained imports during the first five months of the year.

Movements and Classes.	Twelve Months ended 31st May, 1932.		Twelve Months ended 31st May, 1933.		Increase (+) or Decrease (-).	
Imports, c.i.f.—	£'000.		£'000.		£'000.	
Food, drink, and tobacco	405,945		358,351		(—) 47,594	
Raw materials and articles mainly un-manufactured	172,702		158,316		(—) 14,386	
Articles wholly or mainly manufactured ...	227,449		146,506		(—) 80,943	
Other articles ...	8,843		4,095		(—) 4,748	
Total Imports ...	814,939		667,268		(—) 147,671	
Exports, f.o.b.—						
<i>United Kingdom Produce and Manufactures—</i>						
Food, drink, and tobacco	34,093		29,728		(—) 4,365	
Raw materials and articles mainly un-manufactured	45,431		43,805		(—) 1,626	
Articles wholly or mainly manufactured ...	283,421		268,427		(—) 14,994	
Other articles ...	15,262		12,745		(—) 2,517	
<i>Imported Merchandise—</i>						
Food, drink, and tobacco	18,617		12,607		(—) 6,010	
Raw materials and articles mainly un-manufactured	24,639		22,562		(—) 2,077	
Articles wholly or mainly manufactured ...	15,532		10,253		(—) 5,279	
Other articles ...	571		278		(—) 293	
Total Exports ...	437,566		400,405		(—) 37,161	
Bullion and Specie—						
Imports ...	147,827		187,095		(+) 39,268	
Exports ...	176,264		116,802		(—) 59,462	
Movements of Shipping in the Foreign Trade—	Number of Vessels.	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.
<i>Entered with cargoes—</i>						
British ...	28,157	37,712	23,780	35,110	(—) 4,377	(—) 2,602
Foreign ...	25,494	22,935	21,980	20,663	(—) 3,514	(—) 2,272
Total entered ...	53,651	60,647	45,760	55,773	(—) 7,891	(—) 4,874
<i>Cleared with cargoes—</i>						
British ...	34,948	37,124	30,295	33,931	(—) 4,653	(—) 3,193
Foreign ...	19,348	20,260	19,120	19,040	(—) . 228	(—) 1,220
Total cleared ...	54,296	57,384	49,415	52,971	(—) 4,881	(—) 4,413

The value of retained imports of raw materials was greater than in May, 1932, by £1,560,000 (14 per cent.) ; while the increase applied to practically all groups except wood and timber, which declined by £203,000, it affected primarily two groups—hides and skins (£645,000) and rubber (£339,000)—though there was an increase of over £100,000 in the value of retained imports of four other groups, viz. non-ferrous metalliferous ores and scrap, cotton, wool, and oil seeds, oils, etc.

Retained imports of manufactured articles in May were valued at £11,757,000, or £1,130,000 more than in May, 1932. Considerable decreases were recorded in respect of machinery (£241,000)—the decline in tonnage being 9 per cent., iron and steel and manufactures thereof (£163,000)—the decline in tonnage being 41 per cent., and manufactures of wood and timber (£101,000). Two-thirds of the groups showed increases, of which the most important were the manufactured oils group (£394,000), retained imports of refined petroleum being considerably greater than in 1932, both for the month and for the five months; non-ferrous metals and manufactures thereof (£347,000); chemicals, drugs, dyes and colours (£296,000); and leather and manufactures thereof (£191,000).

British exports during May amounted to £30,765,000, showing an increase of £568,000 (2 per cent.) compared with a year earlier. For the first five months of the year there was a decrease of £10,433,000, and the average value of the exports during these months was £29,375,000, so that May compares favourably with earlier months of the year. Exports of raw materials (£4,180,000) during May were higher in value than in any month since October, 1931. Coal was responsible for nearly half the increase in value compared with May, 1932, the quantity exported (3,670,000 tons) being larger than in any month since October, 1931. Increases exceeding 50,000 tons were recorded in the exports to Denmark, Italy, Sweden and Egypt, and there was a decrease of over that amount in exports to the Irish Free State. Exports of wool were nearly twice as large as in May, 1932, and the increase in value in this group (£183,000) represented 30 per cent. of the total increase in value of exports of raw materials as a whole.

Exports of manufactured articles were £344,000 more than in May, 1932. There was a heavy decline amounting to £673,000 in the value of cotton yarns and manufactures, but the value of the exports in May this year was £275,000 more than in May, 1931. Exports of non-ferrous metals and manufactures thereof were £410,000 more than a year ago, iron and steel improved by £369,000, vehicles by £277,000 and electrical goods and apparatus by £136,000,

but chemicals and machinery declined by £151,000 and £111,000, respectively. Cutlery, hardware, implements and instruments, and coke and manufactured fuel each showed a large relative increase, and apparel, paper and cardboard, and manufactured oils a considerable decline. These movements were similar to those recorded for the first five months of the year except in the case of the iron and steel group—which for the five months declined by £389,000—coke and manufactured fuel and the manufactured oils group.

For the five months January to May, exports of iron and steel and manufactures thereof were about 7 per cent. less in tonnage than in the corresponding period of last year, but exports during May were substantially greater than in May, 1931 or 1932, there being considerable increases in respect of tinned plates, wrought tubes and railway material compared with either of those earlier months. Exports of locomotives also showed a marked increase, as did exports of motor cars and chassis, though exports of these during May were not at quite the high level reached earlier in the year. Exports of machinery and of ships and boats were appreciably smaller than in May, 1932, and this applies also to the five months ended May.

The quantity of both cotton yarns and cotton piece-goods exported was substantially less than in May, 1932, though greater than two years ago, exports of piece-goods to India and British West Africa in particular showing heavy declines. On the other hand, exports to British South Africa, Colombia and Argentina were much larger than in May, 1932. For the five months ended May, exports of piece-goods were about 2 per cent. less than a year ago. Exports of woollen goods in May were greater than in the corresponding month of either 1931 or 1932, tops, yarns, tissues and carpets all showing a considerable increase. Linen tissues and artificial silk piece-goods were also greater than in either of those months.

The volume of exports during the first quarter of the year, as calculated by the Board of Trade, was practically the same as in the first quarter of 1932. Both manufactured articles and raw materials showed an increase, but there was a considerable decline in the volume of exports of food, drink and tobacco. Retained imports declined in volume by 7 per cent. The decline was mainly in respect of manufactured articles, imports of food, drink and tobacco declining by only 3 per cent., while retained imports of raw materials,

though 7 per cent. less than in the first quarter of 1932, were larger than in any other quarter of that year.

Imports of bullion and specie during May, £32,750,000, were higher than in any month since September, 1919. The excess of imports over exports during May and during the first five months of this year amounted to £27,961,000 and £57,221,000, respectively, while for the twelve months ended May imports exceeded exports by £70,293,000.

The general level of *wholesale prices* in Great Britain as measured by the Board of Trade index-number declined slightly in April, although towards the end of the month there was a hardening in some directions. The index-number for the month was 81·3 compared with 81·7 in March and 85·7 in April, 1932. Over the twelve months general prices have fallen rather more than 5 per cent. Prices of articles other than food have, on balance, fallen but slightly, but prices of food show a decline of over 12 per cent., cereals having fallen 11 per cent. and other food prices (excluding meat and fish) as much as 21 per cent. Meat and fish prices generally have fallen, but prices of bacon and English mutton have advanced considerably and for some qualities are as much as 20 to 30 per cent. above prices ruling in April, 1932.

The index-numbers for April, 1933, and for March, 1933, and April, 1932, are given below :—

Averages for 1930 = 100.

Month.	Total Food.	Total not Food.	All Articles.
April, 1933	79·6	82·3	81·3
March, 1933	80·6	82·4	81·7
April, 1932	90·9	83·0	85·7

Between March 22 and May 17 the *Economist* fortnightly index-number of wholesale prices has advanced 4·2 per cent., from 59·8 to 62·3 (1927 = 100), the rise being chiefly in the prices of textiles (8·2 per cent.). The price of middling American cotton had advanced to nearly 6½d. per lb. at the end of May, an increase of more than 2d. since the end of May, 1932. The price of rubber also had practically doubled during the same period.

According to the *Statist* index-number there was an advance in general prices during April of 1·9 per cent., the figure for the end of March, 1933, being 77·0 and for the end of April 78·5. (1866-77 = 100), the most marked changes being in the prices of textiles and

other minerals (*i.e.* cotton, tin and copper). As compared with April, 1932, there was a decline in the index-number of 4.9 per cent.

The position of the British index-numbers as compared with those of the gold-standard countries is shown below.

	Board of Trade (1930 = 100).	<i>Economist</i> (1927 = 100).	<i>Statist</i> (1866-77 = 100).	U.S.A. (Brad- street) (1913 = 100).	France (<i>Nat. Gen.</i>) (1913 = 100).	Germany (<i>Stat. Reichsanst.</i>) (1913 = 100).
December, 1932 ...	84.5	61.1	77.7	73.7	390	92.4
March, 1933 .	81.7	59.8	77.0	71.0	385	91.1
April, 1933 ...	81.3	61.4*	78.5	75.8	384	—

* At 3 May, 1933.

According to the *Bankers' Magazine* index-number of Stock Exchange Securities there has been little change in the prices of those with Variable Dividends since the beginning of the year and a rise of about 2.8 per cent. in the prices of Fixed Interest Stocks. At April 19 the general index-number stood at 112.4 compared with 111.2 at March 18 and 110.2 at the middle of January. The index-numbers for Fixed Interest Stocks for the same dates were 120.2, 118.4, and 116.9, and for Variable Dividend Securities 96.3, 96.2, and 96.4.*

According to the index-number compiled by the Chamber of Shipping and published in the *Statist* shipping freights declined during April and were about 2.7 per cent. lower than in March and 15 per cent. lower than in April, 1932. The number for April, 1933, stood at 17.26 compared with 17.74 in March, 1933, and 20.31 in April, 1932.

Returns relating to retail sales prepared by the Incorporated Association of Retail Distributors and the Bank of England and published in the *Board of Trade Journal* show that for the months of March and April there was a decline of about 1.5 per cent. as compared with the money value of the sales in the corresponding period of 1932. The variation in the Easter holidays affects a separate comparison of the two months. It is to be noted that both wholesale and retail prices have declined over the period to a greater extent than the amount of the retail sales.

There has been a gradual fall since the beginning of October, 1932, in the *retail prices* of articles of working-class consumption as recorded by the Ministry of Labour index-number and at the beginning of May, 1933, the total index-number showed a rise of

* At May 19, 1933, the index number stood at 112.5 (Fixed Stocks 118.1 and Variable Securities 100.4).

36 per cent. only above the level of July, 1914. Food prices had increased but 14 per cent., a fall of nearly 9 per cent. having taken place since the beginning of October, 1932. Since the latter date also slighter declines have taken place in the cost of clothing and fuel and light, but, on the other hand, there has been a slight rise in rents (rather less than 1 per cent.). Previously the index-number for rents had remained stationary for more than two years and the rise, although slight, is somewhat disconcerting. Part of the fall in food prices is no doubt seasonal, but part is due to the steady weakening of the prices of some dairy products, especially butter. On the other hand, bacon prices seem to be steadily strengthening.

The following table gives for the principal foreign countries and the Overseas Dominions the percentage increases in July, 1932, and on the latest available date, of the retail prices of food and other items compared with the prices at July, 1914.

	Retail Prices of Food at		Retail Prices of all Items at		Date of Latest Returns.
	July, 1932. %.	Latest date available. %.	July, 1932.	Latest date available.	
Great Britain	25	14	43	36	1 May, 1933
<i>Overseas Dominions, etc.</i>					
Australia	23	13	22 (figure for 2nd Qr., 1932)	22	March, 1933
Canada	-8	-7	25	22	April, 1933
Irish Free State	34 *	35 †	53	51	Feb., 1933
New Zealand	8	1	31 *	26	March, 1933
South Africa	-6	-5	17	13	March, 1933
<i>Foreign Countries.</i>					
Belgium	—	—	608	609	April, 1933
Czechoslovakia	9	9	2	4	Dec., 1932
Denmark	15	17	54	57	April, 1933
Egypt (Cairo) **	8	7	28	30	Feb., 1933
Finland	756	745	894	880	March, 1933
France (Paris) **	443	418	417 †	423 §	April, 1933
Germany	14	6	22	17	March, 1933
Holland (Amsterdam)	—	—	41 ||	38	March, 1933
Italy	318	312	—	265 ¶	Feb., 1933
Norway	34	30	49	47	March, 1933
Spain (Madrid) **	79	81	—	—	Feb., 1933
Sweden *	28	21	56	53	March, 1933
Switzerland	24	16	38	32	March, 1933
United States	1	-9	36 ||	32 ††	Feb., 1933

* Figure for August, 1932. † Figure for November, 1932. ‡ Third Quarter, 1932. § First Quarter, 1933. || June, 1932. ¶ July-December, 1932. ** Fuel and Light included in figures for Food. †† December, 1932.

Unemployment at the end of April, 1933, showed a further improvement following on the decreases recorded at the end of January and February and the rate of unemployment (21·2 per cent.) in the insured trades is now lower than at any date since the end of March, 1932, when it was 20·8 per cent. The decrease in the rate as compared with the end of April, 1932, is, it must be admitted, very slight (0·1 per cent.), and the number on the registers of the Employment Exchanges is still 45,000 more than at the end of April, 1932. The decrease in the numbers on the registers since the end of January has, however, been much more considerable than over the corresponding period of 1932, being about 205,000 as compared with 76,000. Some seasonal improvement may still be looked for, but in cotton manufacture and in coal-mining, two of the most important export trades, there has been a fairly general decline during the first four months of this year. With the exception of the jute and hemp trades all the textile trades have a higher rate of unemployment than at the end of April, 1932. Shipbuilding still continues to show the highest rate of unemployment in the insured trades (59·9 per cent.). The monthly figures issued by the Ministry of Labour showing the numbers of unemployed persons on the registers of the Employment Exchanges are given below :—

Date.	Wholly Unemployed.	Temporarily Stopped.	Persons normally in Casual Employment.	Total.
December 19, 1932 ...	2,171,175	454,522	97,590	2,723,287
January 23, 1933 ...	2,280,033	524,229	98,803	2,903,065
February 20, 1933 ...	2,241,168	512,587	102,883	2,856,638
March 20, 1933 ...	2,170,252	503,377	102,555	2,776,184
April 24, 1933 ...	2,070,814	527,418	99,402	2,697,634
<i>April 25, 1932 ...</i>	<i>2,031,888</i>	<i>516,563</i>	<i>103,730</i>	<i>2,652,181</i>

Unemployment in Germany has decreased continuously since the end of January, 1933, and at the end of April the number of persons available for and seeking work had fallen to 5,534,800, a reduction of 584,000 as compared with the end of January. Of these, 5,333,000 were recorded as definitely seeking work. Included in this latter number were 530,000 receiving standard benefit, 1,408,750 receiving emergency benefit and 2,263,400 able-bodied persons in receipt of poor relief. On the other hand, the proportion of trade unionists unemployed had increased at the end of March, 1933, to 52·7 per cent. as compared with 46·2 per cent. at the end of January, and 47·4 per cent. at the end of February. The membership covered by the trade union percentages cover about two

and a quarter millions as compared with four and a quarter millions in 1931.

In France employment continues to show very slight improvement, although the numbers on the registers of employment exchanges show a slight reduction. The monthly special investigation covering industrial and commercial undertakings employing at least 100 workers still continues to show a decrease in the numbers employed compared with a year ago. The percentage decrease has, however, for the last six months been small and at the beginning of April was only about 1.8 per cent. About 24 per cent. of the numbers employed were working 40 hours per week or less.

In Belgium about 21.0 per cent. of the 957,000 members of subsidized unemployment funds were unemployed at the end of February, 1933, as compared with 22.1 per cent. at the end of January, and 21 per cent. at the end of February, 1932.

In the Scandinavian countries employment improved during the first three months of the year, but on the whole was appreciably worse than in the same period of 1932.

In Italy there has been some improvement since the beginning of the year, and the numbers recorded as unemployed in the statistics of the National Social Insurance Fund had fallen to 1,081,536 by the end of March, a decline of nearly 144,000 as compared with January. As compared with March, 1932, a slight increase is shown.

Judging from such figures as are at present available there has been no general improvement in employment in the United States. There was some increase in the numbers employed in February in the returns received by the Federal Bureau of Labour, but a decrease was recorded in March. According to the statistics of the American Federation of Labour, 34 per cent. of its members in 24 cities were unemployed during the first three months of the year. The official monthly index-number of employment in manufacturing industries was 57.5 (1926 = 100) for February, 1933, compared with 56.6 for January and 65.6 for February, 1932.

In Canada employment declined during the first three months of 1933 and at the beginning of April the index-number of employment was 76.0 (1926 = 100) compared with 78.5 at the beginning of the year and 87.5 at the beginning of April, 1932.

The Ministry of Agriculture monthly index-number of the prices of home-grown agricultural produce in England and Wales for the first five months of 1933 averaged 104.4 as compared with 103.2 in the preceding six months. This may perhaps indicate some faint improvement in the general level of agricultural prices,

although, owing to their seasonal character, the figures are, strictly speaking, only comparable with the corresponding months of preceding years. In the first five months of 1932 the index-number averaged 117, so that the decline this year is about 10 per cent.

Wheat prices were fairly stationary from January to April, but increased in May and still more in June under the influence of unfavourable reports of the United States crop and the depreciation in the dollar. The *Gazette* price of British wheat was 6s. 5d. per cwt. in the middle of June as compared with 5s. 4d. at the beginning of May. Both wheat and barley stood at or near the levels reached in the preceding year, but oats were some 30 per cent. cheaper. Among live stock, fat cattle have been realising poor prices this year and in May were 20 per cent. below last year's level. Sheep, on the other hand, were some 7 per cent. dearer, while pigs, though slightly higher, showed no marked appreciation.

The monthly index-numbers published by the Ministry of Agriculture for the past five months, with comparative figures for the two previous years, are given below (1911-13 = 100).

	Jan.	Feb.	Mar.	April.	May.
1933	107	106	102	105	102
1932	122	117	113	117	115
1931	130	126	123	123	122

It will be convenient here to bring to the notice of Fellows a number of official statistical publications which do not readily lend themselves to review but are of unquestioned interest and utility. The Department of Industry and Commerce of the Irish Free State have recently published a Report (P. No. 844) on *Census of Industrial Production, 1926 and 1929*. The gross output of industrial production was valued at £59,477,000 in 1926 and at £63,402,000 in 1929. The net output similarly rose from £23,078,000 to £24,932,000, and the net output per head from £225 to £233. The expansion in net output was 8 per cent., while the number of persons employed rose only by 4.2 per cent., from 102,515 to 106,838, and the net output per head increased by 3.6 per cent. Food, drink, and tobacco accounted for 30 per cent. of the net output in 1929. Including agriculture and fisheries as well as industrial production and industrial concerns not covered by the Census of Production and eliminating all duplication, the estimated annual output of material goods in 1929 was £116,900,000 exclusive of customs and excise duties. The Department of Trade and Commerce for Canada published in 1932 *Monthly Indexes of the Physical Volume of Business*

in Canada, covering the post-war period from 1919 to 1932. The data included are, for example, imports of raw cotton, rubber, etc., exports of timber, woodpulp, etc., production of coal, flour, iron and steel, boots and shoes, etc. In all there are 84 tables. The Empire Marketing Board have issued a Report (E.M.B. (T.P. 24)) on *Production and Trade of the British West Indies, British Guiana, Bermuda, and British Honduras*. The tables cover population, agricultural production, and distribution of trade, and naturally the bulk of the figures relate to imports and exports.

We welcome a new-comer into the long list of statistical annuals. The Statistical Department of the Kingdom of Yugoslavia have issued in Serbian and French their first *Annuaire Statistique* for the year 1929. It is a comprehensive volume covering the usual categories of statistics. The periods covered in the various tables are not always the same, but this is a venial fault when a new field is being explored. For exports and imports figures for 1920-29 are given. From Sweden through Sveriges Officiella Statistik we get *Detaljpriser och Indexberäkningar* for 1913-1930 (published in 1933). A short summary in French will enable the reader ignorant of Swedish to study these tables of retail prices and index-numbers, even though he must leave on one side the long exposition which occupies most of this slim book of 160 pages. The twentieth volume of the 6th series of *Annali di Statistica* deals with "Dinamica dei prezzi delle merci in Italia dal 1870 al 1929" (Ernesto Cianci). Out of 558 large octavo pages, 246 are taken up with tables of prices of individual commodities, and the rest of the book criticizes, elaborates, and explains the data. Confederazione Generale Fascista dell' Industria Italiana has also issued its *Annuario* for 1932, which, though not statistical, will be of interest to those who study the workings of the "Corporative State." Finally, we welcome the *Konjunktur-statistisches Handbuch* 1933, published by the Institut für Konjunkturforschung at Berlin. The material included is that common to statistical abstracts, the period covered is usually 1924-32, and the presentation is clear and succinct.

In recent years the policy of the United States towards the immigration of aliens has been radically changed by the adoption of the national-origins plan of restricting immigration. The size of the immigrant quotas allotted to the different countries depends in part upon the attempted division of the white population of the United States in 1790 among the various national or linguistic stocks from which it had sprung, and this division has rested mainly

upon the classification of the white heads of families, enumerated at the census of 1790, according to their probable country of origin, as indicated by their surnames. Such a classification was made by the Bureau of the Census some twenty years ago, but, according to a report of the American Council of Learned Societies, this has not been accepted by scholars as better than a first approximation to the truth. In 1927 this Council determined upon a more intensive enquiry into the question and appointed to carry it out, under the direction of a committee, Mr. Howard F. Barker, an expert in the field of family names and indications of descent derived from them, and Dr. Marcus L. Hansen, an expert in the field of the history of immigration to the United States. The report of this Committee, published in the Annual Report of the American Historical Association for 1931, has recently been reprinted in book form and issued from the Government Printing Office (American Council of Learned Societies, Report of the Committee on Linguistic and National Stocks in the Population of the United States, 1932, pp. 107-441). It concludes a detailed study of distinctive names for the United States as a whole, for each of the States, and for the English, Welsh, Scotch, Irish and German stocks. Using Farr's lists of common English and Welsh names, published in the 16th Annual Report of the Registrar General, and the corresponding lists for Scotland and Ireland, the name patterns characteristic of the four areas of the British Isles have been ascertained; with these as a basis the proportions of names in each of the American States and in the whole country in 1790 which were derived from England, Wales, Scotland and Ireland have been estimated. Various other methods of estimation have been applied and the final classification for the United States as a whole divides the population in 1790 as follows: 60 per cent. English, 9 per cent. Scotch, 9.5 per cent. Irish, 8.6 per cent. German, 3 per cent. Dutch, 2.3 per cent. French, 0.7 per cent. Swedish, 0.8 per cent. Spanish, and 6.8 per cent. unassigned.

"Causal Factors in Tuberculosis" is the title of the report of a statistical investigation undertaken in the Tyneside area under the auspices of the National Association for the Prevention of Tuberculosis. The local tuberculosis mortality rate was known to be considerably higher than that for England and Wales, and it was resolved to make an intensive study of the social conditions and to entrust the work to Dr. F. C. S. Bradbury, a Tuberculosis Officer of the Lancashire County Council, who is the author of the brochure. The enquiry was limited to two districts—Jarrow, where the tuberculosis rate was especially high, and Blaydon, where it was low and the figures were used largely as a "statistical control." The methods

used and the results obtained are set out in full. The general outcome is to confirm the opinion most likely to be formed by an intelligent observer, namely, that the chief predisposing condition is poverty, acting through overcrowding and under-nourishment. The mere fact of overcrowding appeared to be more detrimental to resistance than insanitary conditions, and an insufficiency of milk stands out as the most important dietary factor. The analysis also shows, however, that the excess mortality is partly due to the large proportion in the area of Irish families, the members of which are shown to have a racial predisposition to tuberculosis. Summary tables are provided throughout the book, and the appendix consists of 24 tables giving full numerical details. There is also a good index.

As a result of the interest aroused by Dr. Egon Pearson's paper read before the Society in December last on "Statistical Method in the Control and Standardization of the Quality of Manufactured Products," the Council have decided to form a Section for the purpose of promoting the application of methods of statistical analysis to problems in industry and agriculture. In the last decade or so there have been considerable developments in the application of modern statistical methods to technical problems met with in industry and agriculture. In the opinion of the Council the time is now ripe for the formal provision of facilities which will give those who meet with problems requiring the use of these methods for their solution a common platform for their discussion. There are, on the one hand, special research problems involving careful planning and experiment, such as occur from time to time at an agricultural research institution, or in the research department of a large industrial firm. There are also many problems which arise in the course of routine production and exchange; problems of sampling and testing; questions as to whether measurements taken are used to the best advantage; how far they are adequate for the purpose intended, and to what extent some of them may even be redundant. The facilities provided by the Section will be twofold: (1) the holding of regular meetings, and (2) the publication of a Supplement to the *Journal* of the Society which will be devoted entirely to the study of this aspect of statistical science. It is proposed to hold four meetings each session, at approximately the end of November, January, March, and May. Papers on a subject appropriate to the work of the Section will be read at each of the meetings and will be followed by discussions. The Supplement to the *Journal* will contain the papers read before the Section and reports of the discussions. It will also contain other papers which may be accepted for publication

but not read, abstracts of papers published elsewhere which bear upon the work of the Section, and any other information which will be of interest and come within the scope of the Section's activities.

To obtain the full benefit of the work of the Section it will be necessary to be elected a Fellow of the Society in the usual manner, but in order to provide service for those who are interested in the work but are not able to become Fellows of the Society, arrangements will be made for a class of "subscribers" to the Supplement. These would regularly receive copies of the Supplement and would be able to attend meetings, but they would have no part in regulating the work of the Section. There is evidence that this new development will be of interest to a large number of research and educational as well as agricultural and industrial organizations, and steps are being taken to approach all likely organizations with a view to making them informed of the movement. The first meeting will be held on Thursday evening, the 23rd November next, in the Hall of the Royal Society of Arts, John Street, Adelphi, at 5.30 p.m. In order to carry on provisionally the work of the Section until a Committee and officers can be appointed in the usual manner, the following gentlemen have been appointed by the Council of the Society to act as a provisional Committee :—

Dr. E. C. Snow, Chairman (Hon. Sec. of the Society).

Dr. E. S. Pearson (Department of Applied Statistics, University College, London).

Dr. J. Wishart (School of Agriculture, Cambridge).

Dr. J. O. Irwin (London School of Hygiene).

Mr. A. T. McKay (Boot Trade Research Association).

Mr. L. R. Connor, Hon. Sec. of the Section (Imperial Chemical Industries, Ltd.).

In the obituary notice of Sir Bernard Mallet reference was made to his work upon British Budgets, and to the assistance he had received from juniors. This was intended to refer to the first volume, 1887–1913, and the reference to the second work "containing a good deal of his own individual effort" related to the second and third volumes, 1913–1920 and 1921–1932, of which Mr. C. Oswald George was joint-author.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS.

UNITED KINGDOM—

Bankers' Magazine, June, 1933—The progress of banking in Great Britain and Ireland during 1932 (Balance sheets). Britain's return to gold: *Hargreaves Parkinson*.

Biometrika, May, 1933—A comparison of the semi-invariants of the distributions of moment and semi-invariant estimates in samples from an infinite population: *John Wishart*. An empirical age scale: *Drysdale Anderson*. The probability integral of the correlation coefficient in samples from a normal bi-variate population: *F. Garwood*. A further study of methods of constructing life tables when certain causes of death are eliminated: *M. Noel Karn*. Plural births with a new pedigree: *Julia Bell*. On the application of the Double Bessel Function to statistical problems: *K. Pearson*.

Eugenics Review, April, 1933—Wealth and ability: *B. S. Bramwell*. Family endowment— I, In France and Belgium: *H. H. R. Vibart*. II, In England: *Eva M. Hubback* and *M. E. Green*.

Faculty of Actuaries, Transactions, Part VI, 1933—On graduation by the general formulæ of osculatory interpolation: *A. R. Reid*.

Institute of Bankers, Journal—

April, 1933—The work of the Stock Exchange, Lectures I and II: *Sir Stephen Killik*.

May, 1933—The work of the Stock Exchange, Lectures III and IV: *Sir Stephen Killik*.

June, 1933—Monetary policy and banking practice: *W. F. Crick*.

Lloyds Bank Monthly Review, May, 1933—Navigation laws, 1849–1933: *Prof. J. H. Clapham*.

Ministry of Agriculture, Journal, April, 1933—A census of house martins: *W. B. Alexander*. Pig recording as a factor in pig production: *H. R. Davidson*.

Royal Agricultural Society of England, Journal, Vol. 93, 1933—The calculation of the annual cost of farm machinery and implements: *James Wyllie*. The importance of the progeny test in dairy cattle breeding: *Joseph Edwards* and *J. Hunter Smith*. Notable farming enterprises, III. Mr. Webster Cory's farms, by *D. Skilbeck*, and Messrs. S. E. and J. F. Alley's mechanised farming, by *H. G. Robinson*.

Westminster Bank Review, May, 1933—Industrial Production in Britain and abroad.

INDIA—

Indian Journal of Economics (Conference Number), January, 1933—Papers read and discussed at the Sixteenth Conference of the Indian Economic Association, including: the R. T. C. Scheme of Federal finance: *P. J. Thomas*. Economic depression in India: *L. C. Jain*.

UNION OF SOUTH AFRICA—

South African Journal of Economics, March, 1933—Die Vraagstuk van Prysstabilisasie: *Prof. C. G. W. Schumann*. Women workers in Witwatersrand industries: *Hansi P. Pollak*. Sterling price and exchange movements: *A. G. Charles*. South African monetary policy: *Prof. S. Herbert Frankel*.

UNITED STATES—

American Academy of Political and Social Science, Annals, May, 1933—Whole number on the Administration of Justice.

American Statistical Association, Journal, March, 1933—Statistics in the service of economics: *Irving Fisher*. Analysis of variance as an effective method of handling the time element in certain economic statistics: *Theodore W. Schultz* and *George W. Snedecor*. Scales for measuring the standard of living: *Evelyn G. Tough* and *E. L. Kirkpatrick*. The standard error of the coefficient of elasticity of demand: *Henry Schultz*. The standard deviation as a measure of the intensity of seasonal adjustment: *R. von Huhn*.

— *Supplement*—Some comments on materials for teaching statistics: *Theodore O. Yntema*. The problem of the representative budget in a cost of living index: *Bruce D. Mudgett*. The relationship between wage rates and unemployment: *Emmett H. Welch*. Commercial banking during the depression: *Walter E. Spahr* (with discussion by *F. R. Fairchild*). Physical volume of production of gold, silver, and other commodities: *G. F. Warren* and *F. A. Pearson*. Relationship of gold to prices: *G. F. Warren* and *F. A. Pearson* (with discussion by *E. W. Kemmerer*).

Harvard Business Review, April, 1933—The post-war course of corporate profits as determined by net-to-gross profit ratios: *W. L. Crum*. The beet-sugar industry: a study in tariff protection: *Irvin Bettman, Jr.*

Journal of Political Economy, April, 1933—The expansion of bank credit, II: *James W. Angell* and *Karel F. Ficek*. Werner Sombart and the "natural science method" in economics: *Leo Rogin*. A further note on Holtrop's formula for the "coefficient of differentiation" and related concepts: *Arthur W. Marget*.

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Since the issue of Part II, 1933, the Society has received the publications enumerated below:—

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Severn Barrage Committee, Report. 28 pp. 6d.

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Empire Marketing Board. Barley survey: a study of barley production, exports, imports, marketing, markets and prices in the principal exporting and importing countries in the world. London: H.M.S.O., 1933. 9½" × 7½"; 196 pp. 2s.

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Census of England and Wales, 1931, Counties of Brecknock and Carmarthen (Part I). xxii + 43 pp. 3s. Counties of Cambridge and Huntingdon (Part I). xx + 43 pp. 3s. County of Derby (Part I). xx + 47 pp. 3s. County of Gloucester (Part I). xx + 46 pp. 3s. Counties of Herefordshire and Shropshire (Part I). xxi + 55 pp. 3s. 6d. County of Leicester (Part I). xviii + 35 pp. 2s. 6d. County of Monmouth (Part I). xxi + 36 pp. 3s. County of Northampton and the Soke of Peterborough (Part I). xix + 42 pp. 3s. County of Nottingham (Part I). xx + 34 pp. 2s. 6d. County of Stafford (Part I). xxii + 57 pp. 3s. 6d.

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JOURNAL OF THE ROYAL STATISTICAL SOCIETY

PART IV, 1933.

THE CAUSES OF FLUCTUATIONS OF INDUSTRIAL ACTIVITY AND THE PRICE-LEVEL.

By H. STANLEY JEVONS.

[Read before the ROYAL STATISTICAL SOCIETY, May 16th, 1933, the PRESIDENT,
the RT. HON. LORD MESTON OF AGRA AND DUNOTTAR, in the Chair.]

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(c) Want of Fit of 3·4-year Trade Cycle to 3·2 or 3·66 years.	
(d) Conclusion.	

I. INTRODUCTORY.

THE perplexing problem of the causes of the cycle of trade, and particularly of its duration, still remains to be solved in spite of the enormous amount of statistical investigation which has been devoted

to the study of cyclical fluctuations, especially in the United States. Valuable as recent work has been in proving the sequence of events in a cycle, it does not seem to have brought us any nearer to understanding the real causes of these events; and the statisticians who are occupied with this question seem to have no adequate hypotheses as to ultimate causes on which to work. Progress in any scientific investigation can only be made by formulating hypotheses which seem to constitute the most probable explanation of the facts ascertained by the investigator weighed in the light of all relevant knowledge, and afterwards putting them to the test of further enquiry or experiment. Leaders of thought in the natural sciences are accustomed to make sweeping hypotheses as regards the constitution of the atom, the nature of light, the age of the earth, or the extent and motion of the universe, which have been suggested by their own experiments or observations; and they are not condemned because they cannot produce final proof one way or the other themselves. They broadcast their theories more or less as suggestions, hoping that others will take up or join in the researches necessary to prove or disprove them. Formulating hypotheses suggested by new evidence is a definite service to the progress of knowledge; and it is in the hope of being able to render a service in similar manner that I have at last decided to offer the Society the ideas formed after many years' study of economic facts and statistics relating to the trade cycle, to agricultural production, and to meteorology. The task of verifying the hypotheses which will be developed in this paper is quite beyond the powers of any person necessarily largely occupied with other matters. Indeed the amount of labour involved suggests that co-operative effort will be needed, and that resources beyond those of most private workers must be forthcoming.

This paper is not confined, as my opening remarks might suggest, to a study of the trade cycle. It is a mistake to suppose that the so-called cyclical fluctuations of prices and trade can be isolated and attributed solely to causes specially their own. The whole theory of prices is one and indivisible; for there are actions and reactions between the cyclical causes and effects and those which certainly are not of a cyclical character, or even recurring. I shall therefore have to take into account secular changes of price-level, and of industrial organization, transport and the distribution of population, but intend to omit, as being well understood, annual fluctuations of seasonal character, and shorter fluctuations due to monetary practices, as well as all non-recurring, or "accidental" causes, the effects of which, being temporary and local, are obvious.

It is quite impossible in this subject to follow the usual custom of citing the works of previous writers; for the output of writings

on the price-level and the trade cycle in recent years is such that specialization on that subject alone would be necessary to cope with it. I have done my best to keep abreast of the literature of the subject in English; but do not pretend to have had the time to study the work of modern continental writers. It is not possible to acknowledge the sources of the ideas and suggestions put forward in this paper, because I have kept no systematic notes of my reading; but no statement of an economic character is put forward (unless an authority is quoted) which I have not made my own by testing it in relation to all the facts and economic generalizations known to me.

Perhaps I have been predisposed to accept the theory of a physical cause of the trade cycle by my own education in the natural sciences, which included some study of meteorology, and by the reading of my father's papers and articles connecting the recurrence of crises with the sunspot period. In these—I had better say it once for all—he did not say that sunspots caused commercial crises. He attributed crises to the passing from excited trade to depression; and then suggested that the temporary activity and the slump which followed were caused by plenty and dearth in the harvests of the world's great agricultural regions, and that the weather conditions causing good and bad crops in different years might be dependent on changes in solar activity, of which the increase or decrease of the sun's spotted area is the only visible evidence we have.

My own publications on this subject begin with the last of a series of three articles on the Causes of Unemployment which appeared in the *Contemporary Review* for August, 1909. It was reprinted and published separately in the following year under the title *The Sun's Heat and Trade Activity*.^{*} The subject was followed somewhat further in a paper which I read before Section F of the British Association in 1910, of which a summary only was published, and historical data were brought to bear on the varying length of the trade cycle as an indication of its cause. The subject was developed further and use made of the history of trade cycles in a section on Cyclical Fluctuations of Prices in an article which I wrote for the *Indian Journal of Economics* in 1917;† and in my book *The Future of Exchange and the Indian Currency*.‡ Partly on account of the War and its subsequent reactions I found difficulties in continuing the various series of statistics on the lines which I had started; and so had to abandon for the time being the hope of verifying from

^{*} With a Preface and Summary (P. S. King & Son, 1s.).

† A section of the article on "The Art of Economic Development," *I.J.E.*, Vol. II, pp. 42-6.

‡ Oxford Univ. Press, 1922; Chapters IV and V.

subsequent events the theories I had suggested. I think the time has nearly arrived when statistical work on the relation of crop yields to the weather and to the activity of trade might be fruitfully taken up again.

Before proceeding further a few words are necessary as to terminology. In the United States the term "business cycle" is preferred to trade cycle; but by some authors it is applied to the short period fluctuation of trade activity of 3 or 4 years' duration, occasionally 5 years, as well as to the longer period of not less than 7 years known in England as the trade cycle. The short-period fluctuation seems to be more marked in North America than anywhere else; and for the sake of clearness I shall call it the minor trade cycle, or the $3\frac{1}{2}$ -year period, as that is approximately its average length. The trade cycle never exceeds 13 years in length from peak to peak of activity. Longer fluctuations of price-level, as from 1873 to 1920, may be considered as secular movements—first downward, then upward. I cannot attempt to decide whether there is a cycle of fluctuation longer than a trade cycle—say, of from 40 to 50 years' duration; and therefore shall speak of the "secular rise" or "fall" or "secular increase" or "decrease" of prices and density of population, and so forth; or of the "secular trend."

Various subdivisions of the trade cycle have been used or proposed by different writers, and names given to them. For my own part I have always adhered to a simple division and terminology for the phases of the trade cycle, and shall use them in this paper. The most obvious division of a trade cycle is into a period of prosperity and a period of adversity and depression; but each of these falls naturally into two distinct parts. Prosperity begins with (1) the *expansion*, a period of two or three years, which is characterized by the revival of industrial activity after a period of depression, and continues as a prosperous time of healthy development and increasing volume of business. This passes into (2) the *boom*—a year of inflated credit and frenzied trade, in which prices rise rapidly, if the secular trend is upward. (3) The *collapse* follows inevitably on the boom: prices break, stocks grow, and business begins to slow down. The interest rate is high. The last phase, (4) *depression* supervenes, when adjustments have been made, often after a financial crisis. Industry, after recovering from the worst effects of the collapse, is marking time, and the interest rate is exceptionally low.

After three or four years of depression the next cycle begins with the phase of expansion. I must explain at once, however, that although I have so far followed the usual custom of regarding the cycle as commencing with the recovery from depression, for purposes

of giving dates to the commencement and end of any particular cycle, and of thus defining accurately the length of the cycle, I regard the onset of the collapse as the beginning of the cycle. This can be precisely dated to within a few weeks by the wavering and fall of prices and the rapid growth in stocks of commodities; whereas the time of the passing of the depression into the succeeding expansion is so ill-defined that opinions might differ widely in giving it a date.

II. ECONOMIC MECHANISM.

(a) *Buying Power of Farmers.*

In all countries, in all ages, wherever means of transport have been invented and ways developed, towns have come into being at nodal points, and trade has grown between each town and the rural tracts dependent on it. The industrial revolution has led to the growth of industries in the towns, so that inland trade has become more than ever an exchange of products between the town and country. The mechanization of agriculture and the cheapening of transport, especially the road motor, have increased the tendency to concentration of population in towns so that now, in advanced industrial countries, the total population of the towns already exceeds, or is rapidly tending to exceed, the strictly rural population. This secular trend may, of course, be reversed sooner or later by the dispersion of some manufacturing industries in the villages owing to the increasing availability of electric power supply; but I am not concerned with the future.

Great Britain is a special case. The rapid development of industries here during the nineteenth century, together with overseas trade, made the agricultural populations of many European, Eastern and colonial countries, besides our own, complementary to our industrial population. The buying power of rural areas, at home and abroad, is the major factor in the demand for both production and consumption goods. It largely determines the growth of town industries; and, in the short period, their activity.

Buying power is dependent on income and prices. Town populations have comparatively steady incomes except when reduced as the result of strikes or lock-outs and wars, or depression in foreign trade. The income of the agriculturist depends on the quantity harvested of each product and its price, less the cost of production. In backward tracts it depends on the surplus which can be moved off the farm; *i.e.* is not retained as food or raw material necessary for local consumption. The cost of production does not vary much from year to year, nor does the quantity wanted by cultivators in backward countries for their maintenance; but the

quantity produced of each product and its price are highly variable. Consequently the farmer's net income, and his buying power, are normally highly variable. Great Britain is, of course, in many respects peculiar. In other countries industrial disputes and foreign trade are of less importance; so that town incomes are less variable than here.

Since the farmers buy almost entirely products of towns, the activity of urban industries, and consequently profits as well as wages, depends very largely on the buying power of the farmers of that country, and possibly of neighbouring countries also to an important extent. The financial distribution of the benefits of a bountiful harvest depends, however, on the elasticity of demand. Experience seems to show that in the cases of most agricultural products, especially staple foods, the elasticity of demand is low—usually near unity, and not infrequently less than unity. In the case of perishable produce like fruit, where there is no canning industry, it is definitely less than unity. The buying power of farmers is certainly not proportional to the crop; but depends on other circumstances as well.

The farmer fears most a short harvest coupled with a low market price, which may result either from other countries experiencing good harvests when his district is short or from a bad harvest following bumper crops in one or two years, whether in his own country or other countries. A big harvest reaped at the same time as a good harvest in other countries may be equally disastrous, especially if harvests the preceding year were good; for the cost of harvesting per acre increases with the quantity to be handled. The farmer is lucky when a good harvest coincides with a shortage in other countries; or when a big harvest follows a year or two of failures or shortage.

(b) *Other Ways by which Good Crops Stimulate Trade.*

When the price does not give the farmer much increase of purchasing power there are other ways in which trade is stimulated by good harvests. The lower cost of food means a distinct increase of purchasing power by the non-agricultural population except in countries where the standard of living is high; though the effect is partly deferred if the crop is largely used to feed stock, *e.g.* maize in the United States for pigs. Again, the decreased cost of raw materials stimulates industries almost immediately in the case of cotton and most vegetable materials, and two or three years after good rains in the case of wool and hides.

Besides increased buying power, large harvests increase credit and the supply of free capital, and stimulate trade in this way. A

bountiful harvest is an increase of real wealth, and this forms the basis of credit expansion by merchants as well as by banks. The crop is often pledged to a bank, or to a co-operative credit society which probably borrows from a bank, before it is reaped; and at every stage in passing to the manufacturer or consumer it forms the basis of credit, which may or may not be extinguished when the parcel of the commodity passes to the next holder. Obviously the credit created is larger when prices are high, and especially when prices have a rising tendency.

(c) Condition that Crops Create Free Capital.

An expansion of credit does not create free capital for investment, except in so far as by inflating prices it enables larger profits to be actually realized. At what stage in passing from the producer to the consumer larger profits are realized, and whether by increased volume alone, or only when a larger price margin is created, must be enquired into separately for each commodity and even for each country, as trade organization may differ considerably. We may be sure that increased profits are realized somewhere from larger crops—probably often, for successive periods of a few months or so, by successive stages of merchants and manufacturers. Those retailers who can buy in large quantities sometimes get the major benefit; and this seems to have happened on a large scale recently from 1930 to 1932.

A condition that large crops do create buying power and free capital is, of course, that they are actually marketed and not merely held up. When widely practised, the holding up of crops is an important cause accentuating a depression of trade. If the farmers hold up crops with their own capital, less credit is created; but usually they are indebted to banks, or to money-lending firms or companies, for crop finance; and the banks are willing to have their loans frozen rather than risk an almost certain loss, and so their further credit granting powers are restricted. Whether the holding up be by farmers individually, or co-operatively in gigantic pools, or by merchants who have bought from farmers, the result is that the credit created is stagnant. The progress of business and the freeing of capital for investment await the actual realization of profits.

Even when the profits of large crops are realized by one class or another, it does not follow that the free capital so released will stimulate any pronounced activity in industry. In an industrialized country the industries making machinery and producers' goods generally, and the constructional trades, form an important part of the whole; and if those industries be largely idle, consumers' demand will not be stimulated and the industries making consumers' goods

will not become active—or, if fairly busy, their profits are likely to continue below normal. Certain classes avoid investing in equities on the stock exchange and in new industrial issues. Such capital as they do not require to expand their own businesses they prefer to put into real estate, often borrowing trust money for two-thirds of the cost. If they think the cost of building high and likely to fall, or the rate of interest on mortgage loans high, or if they fear higher local rates, or special taxation of the increment of land values, they will wait before starting to build. The loss of a margin will not be risked by temporary investment in liquid securities. The money will be left idle in a bank. Many merchants invest surplus profits in real estate, and so do numerous successful retailers, and contractors of various kinds. If circumstances put the exceptional profits largely in the hands of these classes, such funds are likely to become temporarily immobilized.

The immediate influence which good or bad crops respectively have upon urban business conditions is not merely a theoretical deduction. It is a well-known fact to anyone who has lived in a nearly self-sufficient country where commercial agriculture is developed. In the United States it has long been the custom for large industrialists to watch the crop forecasts carefully, and to lay their plans for production and sales distribution accordingly. A few large English manufacturers with world-wide distribution of their products have learned to study the crop forecasts most closely and ship to each market in advance accordingly. In India the influence of crops on town business is so immediate and direct that bad crops in the district mean not only a poor year for industries, but reduced income for lawyers, doctors, architects, building contractors, shopkeepers and many others.

III. SECULAR CHANGES OF PRICE-LEVEL.

(a) *Industrial Causes.*

The causes of secular changes of price-level are complex and have no doubt been different during each period of falling or rising prices, though it is probable that there are certain general tendencies which have been in operation for the last 150 years at least. The periods of secular rise and fall of prices should, I think, be dated as follows :—

<i>Rising Price-level.</i>	<i>Falling Price-level.</i>
1789-1810	1810-1849
1851-1873	1873-1896
1896-1920	1920- ?

There are six periods, of which the longest is the period of falling price-level from 1810-1849, *i.e.* 39 years. The length of the second

period of falling price-level was 23 years, and the third period is not yet ended. The periods of rising price-level have lasted for 21, 22, and 24 years respectively.

There is no such thing as a normal price-level. In other words, there is no level about which the price-level would fluctuate only in the cycle of trade, if it were not for isolated and exceptional events like great wars or important discoveries. I hazard the opinion that the price-level must always have a secular trend downwards or upwards in the type of competitive and monetary economic system which developed from the industrial revolution, and has now become world-wide; or at least that it would be accidental if opposite tendencies balanced and the price-level remained stable for a long period,—that is, of course, excluding the hypothesis of international agreement and appropriate action to maintain stability.

Industrial and monetary causes must be clearly distinguished. Of the former the most important is the tendency to reduction of manufacturing costs, owing to inventions, especially labour-saving devices, economy in the use of power and improved and larger-scale organization. Manufactured goods have been greatly reduced in price for these reasons in each of the three periods of secular fall of the price-level already mentioned: cotton yarns, steam engines, printing machinery, etc., during the first period (1810–1849); woollen goods, boots and shoes, paper, watches, electric bells, and so forth, and most kinds of machinery, in the period 1873–1896; and artificial silk, bicycles, gramophones, vacuum flasks and a host of modern inventions and machines during the present period of secular fall. The characteristic experience is that the prices of manufactured commodities fall more in the long run than the prices of raw materials and foodstuffs; and that the prices of goods of modern invention or custom (*e.g.* canned fruits) fall more than the generality of manufactured goods. The published index-numbers of prices do not by any means fully represent the fall in the price-level, if we take into account the multifarious household and personal goods with which civilized man surrounds himself. Of course, the total value of the trade in each class of miscellaneous articles is relatively small; but in certain lines, *e.g.* textiles and motor-cars and cycles, it may be quite considerable.

It is generally supposed that while manufactured goods tend to decrease in price owing to the industries being subject predominantly to the law of increasing returns, the prices of agricultural produce, and indeed all primary products, must rise, owing to the operation of the law of diminishing returns. There is certainly a tendency upward in the prices of all primary products with increasing population and manufacturing power; but during certain periods for

certain commodities it has been completely overborne by other tendencies, and the price of the food or raw material has fallen more than the general price-level. Striking recent examples are wheat, rubber, petroleum, and ores of the certain rare metals. Adequate reasons for this can be given, viz. labour-saving devices in agriculture, or in extraction, improved methods, use of power, large-scale organization in production and in marketing, and reduced cost of transport by land and sea. The recent collapse and present depression must be attributed largely to the extended application of power in agriculture and extraction generally, to cheapening of artificial fertilizers, and to large-scale organization, numerous improvements having become widely effective about the same time and coinciding with mass production and excess capacity in manufacturing industries. It is difficult to give a general truth; but I should say that in no large classes of foods or raw materials has the law of diminishing returns been predominant in countries of Western civilization except in regard to cattle and sheep. Recent experiments with new grasses, and artificial manures for grasses and other fodders, indicate that the cost of raising stock may be strikingly reduced, and vast new areas, now practically waste, may be utilized.

The net result seems to be that the prices of primary products have a secular tendency to fall in the great consuming centres; but decidedly less so than manufactured goods. The principal tendency opposing the fall of the prices of both primary and secondary goods is the increasing resort to combination amongst producers to maintain the price of their product or labour, so as to maintain their standard of living; this being effected, when necessary, by limitation of output. Other industrial tendencies are such as the increase of the world's capital fund, the diffusion of technical information in print, and the improvement in security and public services which organized government has rapidly extended over very large tracts of the world's land surface, all of which tend to lower prices. There is no time for me to consider other industrial tendencies; but I must refer to the enormous importance of the opening up of the interior of continents to international markets by the extension of railways during the last eighty years. Another revolution in the development of transport over extensive backward interior lands seems likely through the development of motor vehicles which can go over rough ground and derive their power from forest products or other local fuel.

(b) *Monetary Causes.*

We may turn now to consider the monetary causes of secular change of the price-level. These may be grouped as (1) changes in

the volume of the circulating medium plus the credit structure of banks and merchants; and (2) changes in the velocity of circulation. A rise of the price-level is caused by an increase of standard money (gold or silver) in circulation; by an increase of other legal tender, whether created by the Government or by banks; by a modification of banking practice such that credits are granted more extensively both as to kind of security and proportion of its market value; and by an increase of security capable of forming the basis of bank credit. This may take place by an increase of the market value of existing marketable wealth; by the creation of new marketable wealth; and by the creation of new obligations by Government and other generally trusted borrowers; provided, of course, that there is a demand for such credit. A change to a more liberal practice by merchants in granting credit, such as granting it to more customers, for larger sums, or for longer periods, also tends to raise the price-level. Velocity of circulation is not something independent of the general structure of business, or which the banks can regulate. It depends on the habits of the people and on commercial customs, and also at times very largely on a psychological cause: the anticipation business men form as to the future course of trade, which leads to acceleration or deferment of their decisions. Any of such causes which enhance the velocity of circulation will tend to raise the price-level. The converse changes in all the foregoing cases will tend to reduce the price-level.

(c) *Industrial Cause of Deflation and Liquidation.*

Monetary causes seem to me always to be secondary—to arise from, and sometimes to accentuate, the truly independent causes. A government has not in the past issued more legal tender, or borrowed more extensively, for the sake of raising the price-level; but because disturbed finances or altered policy, such as a war or public works, required it.* The industrial causes already considered are, on the other hand, primary, and some of them tend to induce monetary changes which react further on the price-level. Thus the lowering of the prices of consumers' goods in the industrial countries due to invention and discovery, large-scale organization and the cheapening of transport is probably responsible for initiating a movement of deflation which may be long continued. A boom like that of 1919-20 breaks partly on account of contraction of consumers' demand at high prices, and partly on account of a real decrease of demand, sometimes attributable to bad harvests; but also, I think, because producers have enlarged their out-

* This was written before the Federal Farm Relief Act was passed by the United States Congress on May 12th, 1933.

put, and competition develops, so that, even if demand were sustained, a reduction of price would be necessary to market the output. Whatever the precise causes which have initiated a particular collapse, producers are soon forced to concentrate, not on increasing output, but on realizing economies. This they mostly succeed in doing; but often working at a loss, costs of production following market price downwards. The downward tendency of prices is accentuated by merchants and manufacturers reducing their stocks and buying only as required; but a more important result is the shock given to credit when the downward tendency of prices is generally recognized and no end to it can be seen. Banks and other creditors then become extremely cautious. Liquidations are forced and a general want of confidence ensues—sometimes a financial crisis; and the collapse passes into depression. Many producers fail; others redouble their efforts at reducing costs by installing new plant, and by amalgamations; or by other means securing economies of large-scale working. The prices of practically all manufactured goods fall for these reasons, and the prices of primary products also, on account of over-production and the reduced demand in the case of raw materials, and in the case of staple foodstuffs mainly on account of over-production.

Until the present period of secular fall of prices there do not seem to have been important economies realized in the production of raw materials and minor foodstuffs, but only in the cost of transporting them. In the case of the major food crops, especially wheat, oats and barley, important economies in farming methods were realized in the 'thirties and 'forties of last century and again in the period 1873 to 1896. The cost of raising wheat was reduced also in each of these periods in another way—by the migration of farmers westwards to bring fertile virgin lands under cultivation in the United States and Canada, and migration further inland in Australia and the Argentine. In the second period Russian landlords adopted large-scale farming; and the Government of India opened immense canal irrigation schemes rendering wheat commercially exportable.

The description just given of the initiation of a seculum of falling prices after a boom with exceptionally high prices will be recognized as applying to the collapse with which any trade cycle begins; and in fact it is the beginning of the first cycle of the seculum. Each secular period of falling or rising prices is made up of a number of trade cycles. The period 1810 to 1849 comprised $4\frac{1}{2}$ cycles; the period 1873 to 1896 $2\frac{1}{2}$ cycles. The half-cycle comes in because I date the commencement of the secular fall of prices from the maximum corresponding with the boom in the last cycle of the upward period,

and its termination at the lowest point in the depression phase of the cycle which proved to be the last of the period of secular fall and the first of the ensuing period of secular rise of price-level. Each cycle in a secular period of falling prices brings a fresh wave of deflation and a renewed pressure to reduce costs of production during the depression. I should like to suggest that the pressure to reduce production costs always leads to more effective results in the second cycle than in the first. This is because manufacturers by that time have become thoroughly convinced that there is no other way of saving their businesses. Hence inventions for lowering costs belonging to the first cycle are widely adopted in the second.

(d) *Operation of Industrial and Monetary Causes.*

I have emphasized the industrial causes of a secular fall of the price-level because they seem to me not to have been sufficiently recognized; but monetary causes have undoubtedly operated at the same time. As already pointed out, the fall of prices due to industrial causes leads to bankruptcies in industries and to deflation by banks. In the period 1811 to 1844 the latter was effected partly by failures of banking firms; in 1873 to 1896 it was a consciously adopted policy, due to a better understanding of the principles of sound banking, and perhaps partly to the experiences of the crises of 1857 and 1866. Insufficiency of standard money probably also played an important part in the restriction of credit relatively to the growth of business. In each of the seculars of falling price-level the population and the fund of industrial capital, and therefore the volume of business, were expanding in Western Europe; and too rapidly for the volume of the circulating medium and the credit based on it. This was true in the first period, of Great Britain as a gold-using country, and of the numerous silver-using countries. Doubtless there was hoarding of gold in France and other European countries, as well as in India. In the second period the demonetization of silver by Germany, France, the United States and other countries must have been an important cause; but this had an industrial origin, as the fall of the price of silver was initiated by the discovery by Pattinson of a commercially applicable method of separating silver from lead. It was then that the leaden roofs of many fine old buildings were sold or stolen. In the present period of secular fall of the price-level a corresponding, if less important, event has been the revalorization of the monetary unit in gold at a low figure by France, Italy and Belgium.

Having briefly reviewed what I suggest are the principal causes initiating and continuing a secular fall of the price-level, let us ask why it comes to an end. One reason seems to be that the tendency

to reduce industrial costs gradually works itself out. When all the major industries have adopted the mechanical improvements that have been invented and proved successful, and large-scale working and organization have been pushed as far as the ideas and ability of the times permit, other opportunities are not understood, and the urge to further reduction of costs slackens. It remains for the ensuing period of secular rise of the price-level to bring out wholly new ideas and discoveries, and place their adoption on a commercial footing, ready to operate when widely known, in the next secular period of falling prices. It is well recognized that inventions involving new principles are usually taken up by capitalists and developed mainly during a period of rising prices. The last such period, 1896 to 1920, is responsible for the motor-car, the metal filament electric lamp, the gramophone, wireless, and the aeroplane; and in the industrial field for such revolutionary ideas as independent electric drive of machines, the use of pressed steel parts, the Diesel engine, scientific management and functional organization, and the planning of continuous mass production. It is the widespread application of these new ideas in industries which is characteristic of the present secular period of falling price-level.

The monetary cause of a seculum of falling price-level coming to an end and changing to one of rising price-level is, I think, generally admitted; namely, increased supplies of gold. In the 'forties were discovered the Californian and Australian gold-fields; in the 'nineties the enormous reef or deposit of the Rand, besides minor fields. The first cycle of trade in a period of secular fall of the price-level does not reduce costs of mining sufficiently to stimulate gold production; but in the second cycle the stimulus may begin to be felt. In the third cycle it is almost sure to become decisive under modern conditions. Unemployment also seems to stimulate people to search for gold in partly developed countries. There are probably dozens of undiscovered gold-fields in the world—I speak with some knowledge of geology—and during the past eighteen months new gold-fields have been discovered in Australia, New Zealand, Labrador, South Africa and elsewhere. For these reasons I have little faith in the forecast of the Gold Delegation of a serious decline in the world's production of gold from 1936 on.*

IV. THE TRADE CYCLE.

(a) *Four Groups of Theories as to Causes:*

Theories as to the cause of the trade cycle are too numerous to mention; but I think those which have obtained some acceptance

* *Interim Report of Gold Delegation of Finance Committee of the League of Nations, 1930, p. 12.*

fall into four groups, the psychological, the monetary, the industrial and the physical. The psychological theory regards the alternation of optimism and want of confidence on the part of business men as normal to human nature. A very slight event, a mere rumour of probable better times, may set all business in a state of greater activity as it does the stock exchange; untoward events immediately make everyone over-cautious. The monetary theory seems to be almost entirely mechanical and puts most of the blame on the banks; omitting to note that bankers are much influenced by current economic events, and are quite clear about the reality of the changes in demand for money. The industrial theory regards the progress of industry as necessarily taking place unevenly. Competing industrialists see the same opportunity at the same time and over-expand the producing capacity of the industry. Collapse and contraction by bankruptcies follow; and when output capacity has been sufficiently reduced and demand has grown with increased population and foreign trade, industrial enterprisers again compete with enlarged or new plants and reduced costs. Mr. D. H. Robertson has been an exponent of this theory and has given us the very useful term "period of gestation" to denote the time which must necessarily elapse between the planning of an increase of production with new plant and the actual marketing of the additional output, which, of course, varies from industry to industry.* Finally, there is the theory of a physical cause: that the activity of trade and industry depends on the harvests, which depend on the weather. The latter, it is supposed, is influenced by some cosmic phenomenon of cyclical character. The theory of a solar cause dates back to a suggestion made by Sir William Herschell in 1801, and a number of writers followed my father in accepting the theory as more or less probable until it seemed to be disproved by a later determination of the sunspot period at $11\frac{1}{8}$ years instead of 10.45 years, which fitted so well with the average interval between crises up to 1857. In recent years the physical theory has been revived by Professor H. L. Moore, who found an eight-year cycle in the harvests of the United States and the rainfall of the Ohio Valley, and ascribed the weather cycle to the transits of Venus.

In my view all these four theories are true in one form or another, in greater or less degree, though not if their authors claim the cause they advocate to be exclusive, nor if the periodic transits of Venus be regarded as the main cause of cycles in the weather, harvests and trade. The industrial and physical causes of the trade cycle I regard as primary, and the psychological and monetary factors as

* *A Study of Industrial Fluctuation*, 1916, pp. 13-25.

secondary, being brought into operation by the industrial and physical causes.

(b) *The Industrial and Physical both Real Causes.*

These last-mentioned causes appear to me to be separate and co-ordinate. In other words, both the industrial and physical are *real* causes,* and both usually act together, or in rapid alternation; but it is conceivable that each might act separately. Modern large-scale industry, which is subject to the law of increasing returns, is, I think, inherently liable to periods of rapid development followed every time by a set-back, more or less severe. Whether all or most industries would naturally go through a cycle of expansion, set-back and recovery in the same period, and especially at the same time, is difficult to say. Perhaps, if the industrial cause were acting alone they would be partly synchronous, partly not. There would seem to be little reason to suppose that the industrial cycles would synchronize in different countries; though perhaps, if the industries of three important countries, say Great Britain, the United States and Germany, became active at the same time for any reason, they would pull the rest of the world with them.

There are real difficulties in attributing the trade cycle solely to an inherent tendency to industrial fluctuation. The tendency, as I see it, is due almost entirely to the economies of large-scale production; and so cannot have been in operation before the industrial revolution. Handicraft industries are subject to the law of constant returns, assuming the supply of the raw material to be practically unlimited. How then are we to explain the fluctuations of the activity of trade and industry in the seventeenth and eighteenth centuries? Statistics of production of tin in Cornwall show cyclical fluctuations of an irregular character right back to the Middle Ages. The official statistics of foreign trade show cyclical fluctuations similar to those of the nineteenth century back to their beginning in 1700; and the maxima and minima accord well with the statistics of prices, bankruptcies, interest rates and dates of commercial crises, so that the cycles can be fixed with certainty, though there may be doubt in some cases as to which of two successive years should be regarded as that of maximum of activity preceding the collapse.

(c) *Historical Evidence of Lengths of Trade Cycles.*

A careful study of the lengths of cycles, going as far back as we have reliable data, yields some important conclusions which are not yet generally recognized. Many years ago I made a study of

* Cf. use of this term by A. C. Pigou, *Industrial Fluctuations*, 2nd ed., 1928, Part I, Chap. IV.

seventeenth and eighteenth century statistics with a view to dating the cycles; and the results were published in the *Indian Journal of Economics*, Vol. II (1917), pp. 43-5. The table there published is reprinted below with one slight change (1810 instead of 1809 as the date of a maximum) and the addition of 1920 and 1929.*

TABLE I.
*Dates of Maxima of Trade Cycles.**

Date of Maximum.	Interval (Years).	Date of Maximum.	Interval (Years).
1929	9	1800	4
1920	13	1796	13
1907	7	1783	13
1900	10	1770	7
1890	10	1763	10
1880	7	1753	11
1873	9	1742	10
1864	7	1732	11
1857	10	1721	11
1847	8	1710	10
1839	14	1700	4
1825	7	1696	10
1818	8	1686	9
1810	10	1677	7
1800		1670	

* Some of these dates are revised in the author's reply to the discussion, see p. 599. The frequency distribution is also revised.

The frequency distribution of the cycles is as follows :—

Duration in years	...	...	4	5	6	7	8	9	10	11	12	13	14	15
Number of cycles	...	...	2	0	0	6	2	3	8	3	0	3	1	0

There is a well-marked maximum at 10 years and there are sub-maxima at 7 and 13 years, and perhaps we may say at 4 years also. There are 28 intervals; and the probability of this being a chance distribution is very small. Even if we go back only to 1783, from which time we have reliable index-numbers of prices, and which is approximately the time when large-scale industry began, we get a similar frequency distribution, except that seven- and ten-year periods are equally numerous. I venture to suggest that if the trade cycle were the result of industrial causes alone, augmented, of course, by the psychological and monetary reactions, the length of recorded cycles ought to exhibit a distinct mode—that is, but one maximum.

* As the early volumes of the *I.J.E.* are not readily accessible in this country elsewhere than in London (in the Society's library), an extract from the article mentioned which explains how the early dates were fixed is reprinted as Appendix I to this paper.

(d) *The Author's Previous Recognition of $3\frac{1}{2}$ -year Cycle.*

The explanation of this peculiar frequency distribution seems to lie in the existence of a shorter cycle, which I refer to as the $3\frac{1}{2}$ -year cycle. The importance of this was first impressed on me in the year 1909 when making a study of the yields of harvests of the United States when preparing the articles on the Causes of Unemployment to which I have referred. Sir Napier Shaw, Director of the Meteorological Office, had published a paper on "An Apparent Periodicity of the Yield of Wheat in Eastern England,"* in which he found a fundamental eleven-year period, and a reversal about the years 1895-96. Applying this method to the yield of wheat in the United States I found a fundamental period of 11.2 years, and reversal about the same years, 1895-96. Similar calculations for the yield of maize and oats gave negative results. Another method gave some evidence of the sunspot period influencing the yield of other crops; but it seemed to me that from the economic point of view the best line of investigation would be to compare the variation of the total agricultural produce of the United States year by year with that country's industrial activity, and with meteorological and solar phenomena. For the total agricultural produce I used a weighted average, the weights being roughly proportional to the average market price of each crop over a long period, as this seemed to be the best measure of its economic importance. The curve gives a slight indication of the sunspot period; but what comes out boldly is a short-period fluctuation of the total agricultural produce, the average length of the period being 3.66 years. I found also that a $3\frac{1}{2}$ -year period in the weather had been recognized in Australia, and by Sir Norman Lockyer in a number of phenomena. The curves of barometric pressure at Cordoba in the Argentine and at Bombay showed this period clearly with a length of 3.60 years. I found a correlation co-efficient between my figures of the total agricultural produce of the United States and the barometric pressure averages of April to October at Cordoba of — 0.437. The same period was recognizable in the curve of solar prominences; though the sunspot period dominated it.

I then proceeded to study statistics of business activity in the United States, and the result was to show how closely they follow the total yield of agricultural produce. Pig-iron production, for instance, shows the $3\frac{1}{2}$ -year period clearly, the fluctuations following the fluctuations of harvests with shorter interval in recent decades than in the middle of last century, as might be expected. The general result of an analysis of the business statistics was to show

* *Proc. of the Royal Society*, Series A, Vol. 78 (1906), pp. 69-76.

that the activity of industry and trade in the United States runs in cycles of 7 and 10 years,—that is to say, in periods embracing either two or three of the $3\frac{1}{2}$ -year periods.

This gave the clue to the peculiar frequency distribution of the lengths of cycles from 1695, which I soon afterwards determined from the dates of collapses and crises, and published at the meeting of the British Association in 1910. The redetermination of cycles for the same period on the basis of the dates of maxima of trade activity and prices was undertaken later and first published in 1917 as reproduced in this paper. It is obvious that the maxima in the curve of frequency distribution represent multiples of the $3\frac{1}{2}$ -year period—that two or three of these short periods make up the usual length of the trade cycle of 7 or 10 years. This interpretation is strengthened by an examination of American economic statistics during the last twenty years. So marked is the fluctuation of industrial activity there in periods shorter than the trade cycle that the term “business cycle” has been applied by several American authors to the short cycle which usually completes itself in 3 or 4 years. Since many business operations, besides the staple crops, are annual in character, the effects of the $3\frac{1}{2}$ -year cycle are combined with the annual fluctuation, and the period is completed sometimes in 3, sometimes in 4 years. If the period were $3\frac{1}{2}$ years exactly we should expect the actual fluctuation to give cycles of 3 or 4 years alternately. Actually the cycle is more often only 3 years in length, a fact the significance of which I shall consider later. This short cycle may be dated in recent years with some accuracy by means of the statistics collated by the Harvard service. For instance, the curve of business conditions, which is a compound of commodity prices and bank debits for 140 cities outside New York City,* shows maxima as follows :—

1920.

1st half of 1923.

Winter 1925–26.

3rd quarter of 1929.

Unfortunately I have not had the time to extend from 1908 to recent years the various series of figures which I published in *The Sun's Heat and Trade Activity*. In attempting to calculate the total agricultural produce of the United States for recent years on the same basis as I had done previously for the years 1866 to 1908, I found that the statistics of crop yields for later years are on a different footing from the earlier United States figures. The unit in which the yield is computed, and the area covered by the returns, have

* As published in the *Harvard Review of Economic Statistics*.

been altered for some of the crops, and I did not have the opportunity of obtaining data for converting my former figures to the new basis. There is evidence, however, that the fluctuations in the $3\frac{1}{2}$ -year period have continued.

Another attempt which has failed has been to calculate in the same fashion the total agricultural produce of the world—that is, a similarly weighted total, which is really an arbitrary total value of agricultural production. Here the difficulty was to obtain consecutive figures for all crops for all countries, especially for the years preceding 1923. I satisfied myself, however, that the total world production of individual crops, such as wheat and cotton, varies substantially from year to year. There is a good deal of compensation as between different crops for the world as a whole; but I am inclined to think that the grand total of all crops, weighted according to relative average value, and perhaps with allowance of lag for certain crops like cotton, which often take many months to reach consuming centres, will be found to show significant variations from year to year, sufficient to have some effect at least on consuming power and trade and industrial activity.* The reasons why variations of harvests in different parts of the world do not compensate one another will appear from the facts regarding cyclical fluctuations of the weather to be stated in the next section.

(e) *Theory of the Causes of the Trade Cycle.*

The opinion I hold as to the origin of the trade cycle may be expressed briefly as follows. There is a fluctuation in the quantities of commercial crops available for marketing averaging about $3\frac{1}{2}$ years in length, which is world-wide in extent, though not quite simultaneous in all countries, and of opposite sign in a few. When crops are good the demand for consumers' goods and certain producers' goods is increased, and industries are stimulated. Further stimulation arises from abundant crops of raw materials. A shortage of crops tends to produce depression of trade and industry; and industrial depression also results from a superabundance of agricultural products when prices are low, if farmers withhold them from sale. There is a minor trade cycle, as it might be called, in some countries, particularly in those of continental extent, which usually gives maxima of activity at intervals of 3 or 4 years. The reason why the trade cycle properly so called is longer than that may be due partly to the existence of a 7- or 8-year cycle, and 11- and 22-year cycles, in the weather and crops, for which there is a good deal of evidence, and which may be important in

* In this connection see note in the Appendix on Mr. Carl Snyder's index numbers of world production of food, tobacco and raw materials.

certain regions. The main reason would seem to be, however, that trade, and particularly large-scale industry, is prone to a fluctuation of activity, but in a period which must be longer than five years. This tendency of business—commercial, industrial and financial—to severe fluctuations is partly due to the psychological states which current economic conditions create in groups of business men, and also partly due to the reactions which arise from the financial and credit customs and organization of the country. The $3\frac{1}{2}$ -year cycle is sufficiently powerful, however, to force the swing of trade and industry to adapt itself to its period, so that the boom, or maximum, of the trade cycle proper must coincide with a maximum of the minor cycle. There seems to be no general reason why the trade cycle sometimes comprises two, sometimes three or even four, of the minor cycles. It may depend upon physical, political or economic causes, usually perhaps of a non-recurring character.

Many authors have ascribed particular trade booms and subsequent crises and depressions to wars. Noteworthy in this connection are the booms of trade in 1810, 1873 and 1920. It is obvious that war on a great scale in Europe must create, or at least greatly intensify, a trade fluctuation. The immense creation of credit and stimulation of industrial output produces an expansion phase of the trade cycle, and the boom follows the conclusion of peace. There is statistical evidence that the maximum of trade activity had already been reached and passed a few months before the outbreak of the Great War in 1914, so that, had there been no war, or had it been postponed, a 7-year cycle, 1907 to 1914, would have been completed. The trade cycle was extended by the Great War to cover another two minor cycles.

The theory which I hold is that the trade cycle is a phenomenon which would continue even if, by some miracle, the harvests throughout the world were to become as certain in their yield as the output of a factory; but that what actually does occur is the disturbance of trade and industry by impulses due to world-wide variations of the harvests which do not wholly compensate and are cyclical in character, so that normally the swing to which business and industry are liable is actually timed by the physical cause which affects harvests. Major political events, or economic events, such as an enormous influx of gold into the monetary system, or universal loss of confidence in banks, may, however, have important effects upon the timing of the trade cycle, and perhaps especially upon its duration—as to the number of minor cycles over which it extends. Obviously any event sufficient to affect the economic condition of a majority of the inhabitants of one or more of the great commercial and industrial countries must have some effect upon the course of

the whole world's trade; and this might just happen to turn the scale, so to speak, and convert a 7-year into a 10-year cycle, or vice-versa.

V. THE CAUSES OF HARVEST FLUCTUATIONS.

(a) *Widespread Effects of Periodicity in Solar Radiation.*

If the rôle of harvest fluctuations as a partial cause, and particularly as a timing agent, of the trade cycle be conceded, it becomes of interest and importance to enquire what are the causes which determine harvest fluctuations and give them, in certain regions at least, a more or less cyclical character. Numerous investigations have been made regarding periodicities in the yield of various crops, in the weather and climatic changes, and in solar, lunar and planetary influences on the earth, in regard to radiant heat, and gravitational and magnetic effects. It is impossible for me to give any adequate idea of the considerable literature which has been accumulating in recent years on these subjects. An incentive to such studies has been the desire to find a sound basis for long-range weather forecasting: even to achieve accurate short-period forecasts for use of aircraft. Magnetic storms and fluctuations of electrical effects of cosmic origin are being studied with renewed vigour so that their interference with radio reception may be understood and, if possible, be forecasted or counteracted.

A cursory survey of published work on these subjects yields two somewhat surprising results: the multiplicity of cycles or supposed cycles which have been discovered, and the very definite correlation which is found between many mundane phenomena and solar activity as exhibited by the sunspots. Numerous cycles have been found in crop variations, in the elements of the weather, such as rainfall, temperature and barometric pressure, wind direction and the shifting of storm tracks, in the flood levels of great rivers, in the density and distribution of wild animals and plants, and in magnetic effects and solar radiation. A periodicity corresponding with the sunspot period has been found not only in the harvest fluctuations and meteorological data, but in the growth rings of trees, the water level of certain lakes, the thickness of laminæ of mud deposited in glacial lakes in Canada and Scandinavia, the frequency of earthquakes, and the state of public health; and in all these cases a reasonable explanation of the dependence on solar activity is forthcoming.

The study of harvest fluctuations has not received so much attention as meteorological and magnetic phenomena: perhaps because they are partly economic in origin, and essentially so in results. The complexity of the subject is baffling to anyone who

cannot specialize on it for a long time. All I can do is to indicate what seem to be important subjects for research. I shall then try to give a summary of the results of investigations of cycles in the weather and in solar phenomena.

(b) *Physical and Economic Causes of Crop Variation.*

In the study of harvests it is necessary to be clear as to which variable is the appropriate one for the problem under investigation. A crop is a variable of three dimensions, so to speak. The area sown varies from year to year; and so do the yield per acre, and the quality of the grain, or other produce. Frequently there are joint products, such as the grain and straw, or the lint and seed of cotton; but the secondary product may, I think, usually be ignored, like all the minor field and vegetable crops, when we are seeking the causes of trade fluctuations. If all the minor crops varied in yield alike from year to year, however, their aggregate effect might be important.

Most investigators—Prof. H. L. Moore amongst them—have been content to seek periodicity in the yield per acre. This is right for establishing the physical cause of harvest variations; but for correlating the latter with fluctuations of trade and industry, the volume of production, *i.e.* area matured times yield per acre, is the essential quantity, because the volume of the crop times the price, minus cost of production, determines the farmers' buying power. It is difficult to gain information about the quality of the produce to which any quantitative value could be assigned, except for wheat and cotton in certain countries; so usually it must be ignored.

It is well recognized that the area sown depends largely upon the relative prices of the produce of the region at the time the land is prepared for sowing; and it is usually assumed that the yield per acre depends only on the weather conditions during the period of growth and harvesting. In reality the conditions affecting both the area sown and the yield per acre are much more complicated; and both economic and physical causes operate in each case.

The area sown is partly dependent on weather conditions at the time for ploughing and sowing, and during the preceding weeks. The ground may be too soft, or in other countries too hard, to be in workable condition; but the latter condition is being rapidly overcome by the tractor. Nevertheless, bad weather conditions may restrict the area sown. The economic conditions which determine or limit the area sown are: the availability of labour and power (animal or mechanical); the price of the crop relative to other crops, taking into account the relative estimated costs of cultivation and especially of harvesting. The crop under consideration must

be fitted into the farmer's rotation, in most countries; and this limits fluctuations of area. In one-crop countries, such as for wheat in Western Canada and parts of the Argentine and Australia, for cotton in Texas, and for rice in Lower Burma, the effect of price on area sown is inverse. Since the farmer does not know how to grow any other crop, or has not the land or implements of suitable kind, or marketing facilities, the only way in which he can recover his financial position after a harvest sold at disastrously low price is to cultivate a larger area next year. There is statistical evidence of this tendency.

The yield per acre is affected by a number of weather conditions both before and during the period of preparing the ground for sowing and during the period of growth. The rainfall may be excessive or defective during growth and may work both directly or through damage by pests. Frosts may occur late. Finally, bad weather at the times of ripening, harvesting or leading to store may ruin a crop for which all other conditions were good.

The chief economic conditions affecting yield per acre are: cost of labour and fuel, etc. for preparing the land, cross ploughing or extra harrowing being used, if labour is cheap; cost of fertilizers; and the probable availability and cost of labour for harvesting in relation to the price of the crop. The farmer will avoid the expense of intensive cultivation when the price is low and/or the cost of labour high.

From the foregoing summary of the principal causes affecting the area and yield of crops, it is evident that prevailing economic conditions have a good deal to do with both. In studying fluctuations of crops in relation to other economic phenomena, it is desirable that the possibility of a rise of price-level and increased activity of industry affecting the farmers' operations in countries where commercial agriculture is fully developed should not be lost sight of. It is possible, indeed, that the trade cycle may be to some slight extent reflected back into the area sown and the volume of the crops harvested.

(c) *Periodicities in Crop Yields.*

There have been a number of investigations into the periodicity of crops of recent years both as to yields per acre and volume of the crop, particularly in the United States and in India. References to some of these are given in Appendix II. The general result is to indicate at least four periodicities: nearly two years, a little over three years, about 7 years, and the sunspot period of 11 years. There are, however, many irregularities, and a want of persistence. The reasons for this will be better understood when we have briefly considered what is known as to cycles in the weather; for cyclical

fluctuations of harvest yields probably depend principally upon weather conditions. A few words must be said, however, about Prof. H. L. Moore's suggested 8- and 4-year periodicities; especially as the Society published in 1919 and 1920 two notes by him comparing crop yields in the United States with those in this country and France. Apparently his periodograms are based upon trials for periods of whole years, with the idea that with data not particularly accurate, an attempt at detail in regard to time in the periodogram would not be justified. I think this was a mistake, for the inaccuracy of data of harvest yields or price index-numbers does not affect the incidence in time of the movements, but only their magnitude. It is conceivable that his 4-year period may be due to the 3.6 and 5.0 year periods which interfere, and that his 8-year period includes the 7.3-year period recognized in weather, and possibly one of 8.36 years, which is solar in origin.

It is also worth mentioning in connection with periodicity of crops that considerable success has been achieved in India by two members of the Indian Civil Service who have respectively investigated the yield of wheat in the Punjab and of rice in Burma. In each case a formula has been devised which gives a very fairly trustworthy forecast of the crop on the basis of the rainfall before and after sowing and the price of the grain about the time of ploughing.

(d) *Periodicities in the Weather.*

Passing on to consider periodicities in the weather, we find that these have been investigated in most countries where there are records of sufficient length. It is usually rainfall, temperature and barometric pressure which have been tested for cycles; and a bewildering number of them have been found, even in this country. A very interesting paper was read before the Meteorological Society by Mr. Joseph Baxendell on "Meteorological Periodicities of the Order of a Few Years." His principal contribution to our knowledge of weather periodicity is the discovery of a very well-marked and permanent 5.1-year variation in the frequency of easterly winds at various stations in England, including the record of Greenwich Observatory extending from 1841 to 1923. In the early part of his paper he gave an excellent summary of the knowledge so far reached in regard to cycles by meteorologists. I cannot do better than give the following quotation from his paper:—

"It has become very obvious to those who have been actively engaged in this work that, quite apart from their mean intensities, apparent meteorological periodicities differ so much in type as to form several distinct classes. First, we have a few that are per-

manent, and practically unalterable, or only slightly variable in length, and any occasional failures or reversals of which are far less frequent than are those of the diurnal variation of temperature in winter. To this class belong the 3.1-year rainfall cycle at Oxford and the 5.1-year *wind direction* one at various places. Then there are several that vary—it may be much—either in period, or phase angle, or amplitude, or (generally) in two or all three of these elements, but the changes in which seem to approximately repeat themselves after some length of time. These, evidently, are *apparent* periodicities, generally (but not always) the sum of two or more ‘interfering’ real ones—the ‘double lines,’ or close groups, in periodograms, found by Turner and others. In a few cases, where our meteorological records are relatively long enough, we have been able to determine the cycle of interference and to disentangle the individual terms perfectly. But the results of even simple interference are often startling; it may operate in two very different ways, and either may easily transform a periodicity out of all ordinary recognition. If the amplitudes of two interfering cycles are nearly alike, the combined or apparent cycle will, around one part of the long ‘cycle of interference,’ have approximately double the range of either, the corresponding phases of the two reinforcing each other for several periods; but at the opposite part of their ‘cycle of interference,’ the phases will practically cancel each other out and there may cease, for some time, to be any appreciable variation. The apparent period will be the mean of the two real ones, except at one critical point when the phase angle will suddenly alter by 180° . Should, however, the amplitudes of the two interfering periodicities differ considerably, the resulting apparent variation will be less changeable in range, and will have a *mean* period exactly equal to that of the more intense of the two which compose it, but its length will vary so much during the cycle of interference that at one time—fortunately not for very long—none but experienced investigators would consider it could possibly be the same. Unfortunately, interference is not always ‘simple,’ as assumed in the foregoing remarks. I shall soon show instances of more complex kinds, my last and most important of which really demands some other distinctive name.

“A third class of meteorological periodicities is constituted by those of a temporary character, and some other unreliable or perplexing ones, *e.g.* cycles which have undergone a serious, abrupt change, which cannot well be ascribed to interference. With this class we are apt to associate—though I fear not very justifiable—periodicities that during a number of recent decades have assumed an important character, but which either appeared suddenly or have grown gradually in intensity from practically nothing to a really notable amplitude. Before their apparent births, no matter how far back our records extend, we can find no certain indications of them.”

From examining numerous papers and monographs I find that the 3.1-year period has been recognized by a great number of workers

in different countries, though there is a slight difference in the length given for the period. Abbott, for instance, in analysing three temperature records in widely separated localities in the United States found a period of 3.25 years and one of 2 years 10 months. Other widely recognized periodicities in weather are those of 5 years, 7 years and a small fraction, 11 years and about 34 years (the Brückner cycle).

The explanation of the existence of so many cycles is yet to be found. Some of them appear to be definitely solar in origin and others terrestrial. A quotation may perhaps be given from a paper by a Dutch observer at Batavia :— *

“ The maxima and minima of the Batavia temperature coincide very well with the minima and maxima of the sunspots. According to measurements of the sun's radiation this value is highest during the periods of sunspot maximum ; we have here a good example of Koppen's paradoxon, that with a hot sun the air temperature near the earth's surface is low in the tropics.

“ The 3 years' oscillation cannot be better demonstrated than in the most regular and demonstrative available example, that is, the air pressure curve of Port Darwin, North Australia.

“ The fluctuations of the 11 years and 3 years periods are phenomena which extend over the whole earth. The 3-year period is the most important of the two, because it has the greater amplitude. . . . ”

Dr. C. E. P. Brooks in reviewing this paper in the *Meteorological Magazine* (Vol. 55, 1920, p. 205) writes :—

“ The solar period is well developed only where the response of climatic to solar conditions is of the simplest, as, for example, on the West Coast of Africa, which shows three periodicities of 11 years (amp. 192 min.), 3.2 years (amp. 180 min.) and 2.1 (amp. 102 min.), together with a secular variation corresponding to that observable in sunspots since 1870.”

De Braak puts forward an hypothesis of resonance in the earth's system of oceanic currents, in which the Polar ice-caps also play their part. It is supposed that the major impact is solar in origin ; but that the period is actually dictated by the time which it takes ice to melt and currents to shift. The reviewer concludes :—

“ And here, it seems, we have the explanation of why these periodicities so frequently persist for a time and then break down. For the solar prominence period is not exactly 3 years but a few months longer, so that it will gradually outstrip the terrestrial

* Atmospheric Variations of Short and Long Duration in the Malay Archipelago and the possibility to forecast them. By C. De Braak. (*Verhandlungen Magnetisch en Meteorologisch.*) (Observatorium te Batavia No. 5, 1919.)

period. After aiding the latter for a few cycles, it will gradually come to oppose it; a periodicity will die out, or perhaps skip a year or two, and reappear at the wrong dates, when the resonance is re-established."

Captain Brunt found the 3.1-year period most clear in the long record of temperature in Berlin; but in examining a large number of continental records he found besides the 11-year period so many longer periodicities that it is impossible to believe they are all, or many of them, real. The well-recognized longer periodicities are 22.4 years, 34 to 35 years and 50 years.

The various meteorological periodicities which are generally recognized, or fairly well authenticated, are set out in Table II below in which they are compared with like periodicities in other phenomena. Analysis by the usual method of the periodogram, and even harmonic analysis, seems to yield a number of periodicities some of which have to be regarded with suspicion, if there is no independent evidence of their reality. It may be worth while to suggest that a good way of settling which are real periodicities will be to search for localities in which a particular periodicity is strongly developed. It appears that there are certain sensitive areas, as they might be called, for each periodicity, where it is so strongly developed as to predominate over others. The 11-year period, for example, is particularly strongly developed in the region of Lake Victoria Nyanza, and the water level of that lake has fluctuated in remarkable correspondence with the curve of mean sunspot areas.*

Assistance may be obtained also from the study of cycles in secondary phenomena. For instance, there are long records of the flood levels in lakes which have no outlet: that is to say, drain to an inland basin; of the advance and retreat of glaciers; and of the thickness of rings of tree growths. In every case these depend upon the rainfall or snowfall of the locality or on the rainfall of the surrounding or neighbouring region.

The only difficulty which applies to the interpretation of the records of flood levels of great rivers is that the river basin may very likely include regions subject predominantly to different periodicities, so that the fluctuation of the level of the main river is a compound of the variations of its principal tributaries.

An excellent example of the use of river levels is an investigation by Dr. C. E. P. Brooks of a long record of the annual flood levels of the Nile, extending from A.D. 641 to 1451, which was compiled from the original Coptic records and corrected to the modern calendar by

* See paper by Sir Richard Gregory on Weather Recurrences and Weather Cycles, *Q.J. Met. Soc.*, Vol. LVI, p. 103, April, 1930.

TABLE II.
Comparative Table of Cycles.

Economic and Crop Cycles.	Price of Wheat. Beveridge	Weather.	Solar Radiation C. G. Abbott	Sunspots and Prominences.	Nile Floods (Brooks).	Growth Rings of Trees Europe and N. America.
		2.3 (f) (e) 2.4 (d) 2.33 2.8 (d) 2.83 3.1 (d) 3.25 (e)	1.75 2.1	2.33 (Clough) 2.7 3.2	2.86	2.25 (2.55)
3.4 (a)	2.735 3.415					(3.2)
3.66 (c)			3.75	3.7 (h) 3.78 (g)	3.66	
	4.415	4.8 (d)		4.8 (g)		
	5.1	5.1 (d)				
	5.667	5.6 (d)	5.66		5.52	5.5
	5.933	5.7 (d)				
					6.83	
7 (b)		7 (f)			7.33	
7 (c)	7.47 8.09	7.2 (d)		8.21 (8.36) (g) 8.67	8.33	(9.5)
10 (b)	9.75			9.75 10.40		
10.4 (Crises)						
11.2 (c)	11.0	11	11.25	11.14 11.125 (g)	11.06	11
	12.05 12.84			12.0	12.5	
13 (b)				13.5 (g)		14
	15.22				14.87	
	17.4				16.08	
	19.0				18.32	(19)
					22.12 (24.43)	
					33.49	
	35.5	35			39.85	38
	54.0	50		52.0		
	68.0				66.0	
				(78.0)	76.8	100

(a) Average of minor trade cycle.

(b) Frequent lengths of the trade cycle.

(c) Crops U.S.A.

(d) European Weather records.

(e) C. G. Abbott, U.S.A. temperatures.

(f) U.S.A. weather.

(g) Schuster's sunspot periods, others mostly Turner's. (h) Solar prominences.

The figures in parentheses are not given with confidence by the authors concerned or are for some other reason doubtful.

Mr. J. I. Craig.* Dr. Brooks found a large number of periodicities which are set out in Table II, and many of which are well-recognized periodicities in weather records in various parts of the world. He found also, however, a few which have not been recorded elsewhere. Fluctuations of lake levels such as the Caspian Sea in the 34-year period and Lake Victoria in the 11-year period have been already referred to, and there are many other examples. It may be of interest to mention that a lake in Upper Burma with no outlet had to be drained by the Public Works Department digging a canal at considerable expense because the railway became frequently flooded in the late 20's of this century, having been constructed no doubt during the dry phase.

Most glaciers show some periodicity in advance and retreat : in the 2-year, 11-year or 34-year cycles; and some give indications of more than one cycle. There is, however, a greater or less lag with reference to the meteorological records. It is, however, in the thickness of the rings of tree growth that some of the longest records of periodicity in the weather are available. This work was initiated on a large scale in the United States and has been extensively pursued by Prof. A. E. Douglass.† Many hundreds of trees have been measured with records extending for three or four hundred years, and many with more than five hundred. That the records are reliable and correctly interpreted may be inferred from the fact that it has been possible to "cross date" them as between different trees over extensive areas, so that the same years of abundant or deficient rainfall are recognized as having similarly affected each tree. Similar results have been obtained with the rings of trees in Scandinavia, North Germany and elsewhere. The cycles found by Prof. Douglass are given in Table II.

There seem to be two main theories as to the causation of weather cycles. Most investigators attribute them to solar influences; but a few have sought to show that they may be due to influences set up by the motions and conjunctions of certain planets. There are two theories of the solar cause : the old one of fluctuations of the sun's radiation of heat and light, and a modern theory that there is a fluctuation in the bombardment of electrons emitted by the sun, which has electro-magnetic effects, and indirectly affects precipitation. I think it may be said that the solar radiation theory has the widest acceptance. It is receiving striking confirmation from actual measurements carried out at several stations; but this does not exclude the possibility that electronic emissions are responsible partly or wholly for some of the observed cycles.

* *Memoirs of Roy. Met. Soc.*, Vol. II, No. 12.

† *Climatic Cycles and Tree-growth*, Washington, 1919; also *Report of Smithsonian Institution for 1931*.

(e) *Periodicities in Sunspots and Solar Radiation.*

To establish the theory of solar radiation as the cause of weather cycles it has been natural to test the coincidence with cyclical changes in the sun's condition which can be actually seen. These are the sunspots and the solar prominences. The former vary in the well-known period of about 11 years, the latter in the 11-year period and in a shorter period of about 3.6 to 3.7 years.

The sunspot cycle is by no means regular, the individual periods varying from 8 years to as much as 17 years in length. Records of sunspots considered to be reliable go back more than 200 years. I have taken the periods from maximum to maximum in whole numbers and have constructed a table of frequency for 28 periods similar to that which I have given for trade cycles, with the following result :—

Duration in years ...	7	8	9	10	11	12	13	14	15	16	17
Number of periods ...	0	3	2	4	9	4	4	0	1	0	1

The variation of length of the sunspot period is well recognized ; and it has been suggested that its variation is periodic in one or more long cycles.

A study of the literature on the sunspot cycle disposes of the facile criticisms of my father's theory of the dependence of the regular recurrence of crises on solar influences. It has been generally supposed by economists that the re-determination of the solar period as 11.125 years instead of 10.45 years, as it was supposed to be when the theory was put forward in the 70's of last century, has effectively disproved it. The fact is, however, that during the period for which there was a regular recurrence of crises at intervals, the average of which was 10.44 years, the actual average length of the sunspot cycle according to modern data was about 10.8 years. It was the inclusion for the purpose of obtaining the average of earlier cycles before 1700 and the addition of those subsequent to 1870 which lengthened the average period to 11.125 years. In fact the average length of the cycles which have occurred since 1870 is 11.6 years.

Prof. Schuster's well-known harmonic analysis of the sunspot data led him to recognize six cycles in the sunspot variations which, stated in order of amplitude, are as follows, in years : 11.125, 8.36, 13.5, 5.56, 4.79, 3.71. Other investigators a few years later, notably Kimura and Prof. H. H. Turner, found a much larger number of periodicities. Prof. Turner's are given in Table II.

It will be of interest here to notice a remarkable paper by Prof. Turner in which he seeks to explain the peculiarities exhibited by solar activity as measured by the mean monthly areas of sunspots.

It is entitled "On a simple Method of Detecting Discontinuities in a series of Recorded Observations, with an application to Sunspots, suggesting that they are caused by a Meteor Swarm due to successive encounters of the Leonids with Saturn, which has more than once been considerably perturbed by the Leonid Swarm." It is an old theory that changes in the sun's activity and intensity of radiation are due to a vast number of meteorites falling into it at certain times. Prof. Turner shows how the swarm of meteorites following an elongated orbit loses meteorites to the sun at perihelion, and may from time to time have its orbit markedly disturbed by passing near one of the planets, especially Saturn, or by actually interlacing with another meteor swarm following a different orbit, which events would explain the apparent discontinuities in the cycles of solar activity. He also gives a mathematical method of proving discontinuity in a series of figures following a periodic law.

No sunspot swarm of meteors has been actually observed; but meteorites are too small to be visible at a distance of millions of miles. We know only of swarms which happen to pass so close to the earth that a few of their meteorites are attracted to the earth. It is conceivable that each of the cycles of solar variation, and of the weather cycles supposed to be due to solar influence, is caused by a separate meteor swarm. In this case the periods of these solar cycles need have no simple relation to one another. The usual tendency is for the investigators to regard these cycles as multiples or sub-multiples of one another; but there is no need for them to be so. In the case of weather cycles, and cycles in prices, periods which are half or double a well-marked period may be explained as due to both the maxima and minima of the longer cycle creating conditions of maximum, or the reverse, in the other phenomenon. Thus, the fluctuation of prices in a period of $5\frac{1}{2}$ years might be due to conditions of poor harvests being caused by the weather cycle at both maximum and minimum of the 11-year period. Excessive dryness and excessive moisture can both produce scarcity of grain.

The reality of cyclical fluctuations of the heat radiated by the sun has been proved in recent years by accurate measurements which were commenced by Mr. C. G. Abbott and Mr. F. E. Fowle at the Smithsonian Astrophysical Observatory at Mt. Wilson in California in 1906. The "solar constant" has proved not to be a constant, but a variable, there being cyclical fluctuations of various periods from a few months to several years. Great difficulty was experienced in freeing the observations from the effects of moisture and dust in the atmosphere; and for this purpose independent observations were undertaken at specially chosen elevated stations, namely Harqua Hala in Arizona, Montezuma in Chile, and in recent years

on a mountain in South-west Africa. The elimination of atmospheric influences is now based on two independent methods; so that the observations must be regarded as correctly representing the variation of intensity of solar radiation. The results as quoted by Mr. Abbott* yield the following periodicities, with amplitudes as in the second column:—

Period in Months.	Amplitude in Sun-calories.
7	0.005
8	0.005
11	0.009
21	0.004
25	0.010
45	0.013
68	0.014
135	—

At this point I should like to acknowledge the very kind assistance I have received from Dr. C. E. P. Brooks, of the Meteorological Office, who has given me much information and many references. I wish also to thank Mr. C. G. Abbott, of the Smithsonian Institution, and Dr. W. J. S. Lockyer, Director of the Lockyer Observatory, Sidmouth, Devon, for kindly supplying me with references and literature.

VI. SYNTHESIS OF CAUSES.

(a) *Mechanism of Cyclical Change of Climate and Effects on Crops.*

It remains for me to attempt to give a general picture of the action of the physical causes upon harvests and of their reaction upon trade and industry; and to indicate in the broadest terms the effects of progressive changes in economic development and social organization upon the features of successive trade cycles. The reactions of the secular trend of the price-level must also be considered.

That the radiant heat received by the earth from the sun varies from year to year has long been suspected, but only lately by the direct measurements under the control of C. G. Abbott just described has it been definitely established. The manner in which cyclical changes of the sun's radiation produce weather cycles is highly complex, but is probably fairly well understood; and may be summarized as follows.

Sunshine beating on the oceans in the tropics and subtropical belts evaporates water faster when the sun's rays are hotter. This happens every year, of course, in subtropical regions on the approach of summer, and is responsible for the monsoon rainfall. The blanket-effect of increased moisture in the atmosphere, as well as actual

* "Periodicity in Solar Variation," *Smithsonian Miscellaneous Collections*, Vol. 87, No. 9, 1932. For further references on the subject of the variation of solar heat radiation, see Appendix II of this paper.

rainfall, cools the climate during the monsoon periods, so that in such countries it is actually cooler in the height of summer than it is before or after the monsoon period. In similar manner in a year when the sun is radiating more heat than during a preceding year the atmosphere in tropical and subtropical regions becomes more charged with moisture, and gradually this condition extends all over the earth. This has two important results: with more moisture in the air rainfall is increased in most places, but decreased in some, owing to changes in winds and ocean currents. Secondly, the temperature at the earth's surface is reduced owing to the absorption of heat by the water vapour in the air. This is the explanation of much controversy over the question whether the sun's radiation is greater at sunspot maximum or minimum. Abbott has fixed a lag of $2\frac{1}{4}$ years in the terrestrial temperature curve relatively to that of solar radiation in the 5.6 years cycle, and a shorter lag for each of the shorter cycles, almost in proportion, the reason being apparently the comparatively local effects of the shorter cycles.*

Brückner showed many years ago that the world's land surface may be divided into regions having a generally moist or "oceanic" climate and regions having a dry or "continental" climate. The former is characteristic of the margins of the great land masses (but on the Western coast often stretching hundreds of miles inland), and the latter of the interior of continents—the great plains or steppes, usually fertile if moisture is sufficient. Since hot air rises, there is low pressure over the continents in summer and high pressure over the oceans. In winter the conditions are reversed. At the beginning of a period when the earth receives more heat from the sun the boundary between continental and oceanic climates is affected, being pushed outwards in summer and drawn inwards in winter.

The cycles in solar radiation and the weather appear to affect crops mainly by varying the moisture—principally through the rainfall. As the maximum of radiation approaches, or is reached, a hot dry year is succeeded by one with rainfall well above the average. In regions of continental climate the usual cause of crops failing is drought; but on the margins of continents, where the oceanic climate prevails, it is usually excessive moisture which damages or destroys the crops. Hence in the hot dry year the harvests fail in the continental regions and are good in coastal regions; and vice versa in a wet year.

(b) *Commercial Crops Extended over Interior of Continents.*

It is obvious that if the areas sown in these two types of climate were equal there would be compensation to such an extent that cycles

* *Annual Report of Smithsonian Institution for 1931*, p. 196.

in weather conditions would have little or no effect on the volume of agricultural produce offering in the world's markets. Since the beginning of the nineteenth century, however, the distribution of crops on the earth's surface has been profoundly modified. Inland transport was so costly, except along the great rivers, until the building of railways, that international trade in grains was practically confined to the coastal regions. The market was dominated by success or failure of the crops in the regions of oceanic climate. The opening up of the great continental plains for commercial agriculture, first by steamers on the rivers and then by railways, enormously extended the cultivation of cereals in regions of dry climate, until gradually markets came to be dominated by the success or failure of harvests in the interior of continents.

Wheat cultivation spread in the second half of the nineteenth century throughout the warm dry interior of continents, wherever rainfall was sufficient in most years and transport facilities were developed. With the adoption of "dry" cultivation in the semi-arid tracts of the western United States the area has been considerably extended during the present century. There has been, of course, an actual contraction of the cultivation of wheat, except when heavily protected, in regions of oceanic climate, like the British Isles, because a comparatively dry climate suits it better.

The opening of the Panama Canal, the practical elimination of Russia from the markets of the world as a seller of agricultural produce on a large scale, and the immense extension in India of the area protected or developed by canal irrigation, the development of commercial crops like cotton in Kenya and the Soudan, and the extension of cultivation in W. Australia and the Argentine, are all factors of economic importance likely to change in some degree the fluctuation of the world's total agricultural produce as the result of weather cycles.

Of course, there are numerous other factors which have come into operation of recent years such as tariffs and subsidies in aid of agricultural producers, and changes of demand, especially the substitution of meat and various minor foods for wheat in many countries. All these are secular changes, likely in many cases to have permanent effects. I mention them to show that it would be foolish to expect the response of the world's economic system to climatic cycles to remain unchanged when the system itself is in a state of rapid development. Such considerations show that each trade cycle must be studied in the light of the conditions of development of industry, transport and trade which characterize it and its predecessors. They also warn us that attempts to draw conclusions from correlations of long series of figures of crops, industrial

production and other economic phenomena, not of a purely local character, should be regarded with some suspicion, and be judged in the light of information available as to changes in the material basis of our civilization, no less than the habits and distribution of the world's population.

The whole subject is excessively complicated; and all I am able to do is to give a simplified general idea of the physical and economic fluctuations and secular changes. For instance, the causation of the weather, particularly in the coastal regions, is far more complicated than I have indicated. There is a well-marked cyclical shift of the storm tracks over North America and the North Atlantic both in the 3-year and 11-year weather cycles; and, of course, the frequency of storms in a locality is an important factor in its pressure and rainfall records. The number of cycles and pseudo-cycles discovered in meteorological phenomena suggests that there are centres or areas from which the impulses of extra-terrestrial energy fluctuations start spreading themselves as the atmospheric circulation proceeds with its swing; but modified and even reversed by prominent physical features, such as mountain ranges, and perhaps subject to something like an effect of reflection from ocean currents, which change with a lag varying according to the length of the cycle.

(c) *Want of Fit of 3.4-year Trade Cycle to 3.2 or 3.66 years.*

There are still some questions unsettled in the connection of trade fluctuations with weather cycles. For instance, I stated earlier in this paper that if the minor trade cycle were exactly $3\frac{1}{2}$ years in length we should expect the actual fluctuation to give periods of 3 and 4 years alternately; whereas this cycle is most often 3 years in length, sometimes 4 years and occasionally 5 years. When preparing my paper for the British Association in 1910, to which I have referred, I estimated the length of this period by counting the number of cycles from 1907 back to 1695. I counted 62 periods and found their average length to be 3.42 years, as can be seen in the published summary of the paper. I stated that the discrepancy between this figure and 3.7, the period of the solar prominences, and 3.6, the period of fluctuation of the barometric pressure at Bombay, Cordoba and many tropical stations, required further investigation. This question has received my attention at intervals ever since. It was most interesting to find that Sir William Beveridge in his analysis of the fluctuations of wheat prices found a distinct maximum in his periodogram at 3.415 years. Yet I can find no physical cycle even suggested with a periodicity of that length. The explanation I would now suggest is that economic phenomena are liable to follow either of the two well-established cycles of 3.2 (or 3.1) years and 3.6 (or 3.66) years. Per-

haps the 11.2-year solar, or the 10.4-year cycle, imposes itself, so that there is a jump from one to the other of these two short-period cycles; or it may be that wars, or non-recurring economic events, have effected the change. It may be that crops in some regions respond mainly to the 3.2-year cycle, and in other regions, as in the United States, to the 3.6-year cycle; and that some long-period fluctuation brings first one, then the other, of these types of regions into play as the predominant influence on commercially marketed crops.

(d) *Conclusion.*

A section of this paper was devoted to secular changes of price-level; but I have said nothing about secular climatic changes or long cycles. It is well established that slow secular changes of climate have been taking place in several countries over many centuries; but these are not fluctuations of the type with which we are concerned. There are, however, some well-recognized long cycles the possible economic influence of which must not be overlooked. Those usually recognized are 34 years and 50 years; and 68 years and 100 years are suggested. I have no evidence to suggest that so-called secular economic changes are due to these longer weather cycles in any degree, and do not suggest it; but it may be of interest to note that civil engineers are becoming alive to the importance of acquainting themselves with the longer cycles in rainfall. So many instances have occurred in various countries of highest recorded flood levels having been overtopped, and dykes or dams burst, and of drainage allowed under railways, etc., having proved insufficient, and so causing floods, that engineers are beginning to enquire as to what phase of a long cycle the records on which they rely relate.

The purely economic phenomena of fluctuations of prices, business and industry have received so much attention from economists that my tendency in this paper has been to omit considering them, and to concentrate on those aspects of the problem which are less well known. My view is that physical causes are probably important, but not all-important in the generation of the trade cycle; but that, once it is set going, the successive phases of the cycle are mainly an economic phenomenon, and must follow one another in the well-known order. At the same time, good or bad harvests impinging on the cycle of economic activities may alter its tempo and may bring it to an end or extend it.

Confirmation or disproof of hypotheses such as are contained in this paper awaits the result of detailed statistical investigations. So far, in this country, both in meteorology and in economics, statistical investigation of fluctuations and cycles has had to be undertaken by individuals, mainly in their spare time and with little or no financial

assistance from public sources. This is not as it should be. The question of settling definitely the meteorological cycles is one of paramount practical importance for agriculture, and of interest to the general public, because such knowledge would render feasible long-range weather forecasting with sufficient accuracy to be of great service. Knowledge of the weather cycles and their correlation with crop cycles in different countries would also be of the greatest value to economists, as the foundation of an intensive statistical investigation of industrial fluctuations. Governments and universities should devote to meteorology and economic statistics funds for research on the same scale as those devoted to astronomy, geology, physics and chemistry. The methods of investigation have already been developed by independent workers in many countries. All that is needed is large-scale research organization to apply them to these problems which remain in many respects so baffling, and the solution of which is of more than ordinary importance to civilized mankind.

APPENDIX I

(Extract from article on the Art of Economic Development, section on Cyclical Fluctuation of Prices, by H. S. Jevons, *Indian Journal of Economics*, Vol. II, pp. 43-5.)

There is no index number of prices for the century preceding 1782; but the course of prices can be inferred fairly accurately from the total value of foreign trade, as may be seen by comparing prices and trade in the nineteenth century; and fortunately we have official returns extending back to 1700. The maximum of foreign trade does not always coincide exactly with the year of maximum prices; and two other sets of figures have enabled me to make the necessary verification or correction one way or the other. Back to 1731 I have used the statistics of bankruptcies,* adopting the rule that when prices are rising rapidly bankruptcies are low, and that the first year of higher bankruptcies after one or two low years is the year of maximum prices in which the turn came. Prior to 1745 I have made use of a series of figures giving the annual production of tin in the mines of Cornwall and Devon as far back as 1667,† and these figures give very striking maxima of production, sometimes in the same year as a trade maximum, but more often in the year following. This latter is exactly what we might expect, as the response of production to high price would not be rapid in those days, and the fall of price was not usually serious until the year following the

* W. S. Jevons, *Investigations in Currency and Finance*, edition of 1885, chart at end of the volume.

† *The Stannaries*, by G. R. Lewis.

highest price. We find the same thing in the nineteenth century in the output of coal, partly owing to the long contract system, that a year of maximum output comes a year later than the year of maximum price. I have little hesitation, therefore, in giving the following list of years of maximum prices; * but should add that those prior to 1700 are based on the statistics of the production of tin only, supported, however, in the case of 1686 by the fact that a crisis began to develop in that year,† and in the case of 1696 by an index-number calculated from Houghton's valuable prices quoted by Thorold Rogers.‡

APPENDIX II

BIBLIOGRAPHY

In this brief Bibliography are printed the references, to books and papers on various economic and scientific subjects, which I collected whilst preparing this paper. It makes no attempt even to approach completeness in any branch of the subject of trade fluctuations and their physical causes; but it may prove useful to other economists who wish to begin pursuing the subject in original sources. Except in the first section, the order of the entries is roughly chronological, the more recent coming first. In some cases a brief note of the contents is given.

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* These dates differ in some cases from the dates of "collapses" given by me in *British Assoc. Rep.*, 1910, p. 683, but the collapse ordinarily came a year or so after the maximum.

† W. R. Scott, *Constitution and Finance of English Joint Stock Companies to 1720*, Vol. I, p. 464.

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Period in Years.	Amplitude.
20.03	10.4
12.05	15.1
11.114	27.5
10.48	14.9
9.99	14.3
8.55	10.6)

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PERIODOGRAM ANALYSIS AND METHODOLOGY

Although outside the scope of the paper, it may be of use to some investigators if I bring together references relating to methods of determining periodicities in series of solar, meteorological or other observations. There is widespread dissatisfaction amongst investigators of such periodic phenomena with the use of harmonic analysis for this purpose; and many varieties of periodogram, and two machines—the Periodometer and the Cyclograph—have been devised to facilitate the work.

Periodogram Methods.

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ABBOTT, C. G., in "Weather Dominated by Solar Changes," *Smith. Misc. Coll.*, Vol. 85, No. 1, 1931, has described his particular periodogram.

SHAW, SIR NAPIER. *Manual of Meteorology*, Vol. I (1926), pp. 272-86.

BROOKS, DR. C. E. P. The Difference-Periodogram: a method for the rapid determination of short periodicities. *Proc. Roy. Soc.*, Ser. A, Vol. 105, 1924, p. 346.

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Machines.

The Periodometer is described in:

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The Cyclograph, a machine of mirrors, a light and lenses, invented by Prof. A. E. Douglass, is described in the Report of two Conferences on Cycles at Washington mentioned above, and in the *Report of the Smithsonian Institution for 1931*, p. 307.

A Harmonic Analyser with variable period and amplitude, devised by Dr. C. F. Marvin, is described in the *United States Monthly Weather Review* for December, 1929.

Methodology.

MARVIN, DR. C. F. Arc Meteorological Sequences Fortuitous? *United States Monthly Weather Review*, December, 1930, pp. 490-3.

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DISCUSSION ON MR. JEVONS'S PAPER

DR. E. C. SNOW: There are particular reasons for expressing our thanks to Mr. Stanley Jevons for his paper this evening. Though Mr. Jevons promised his paper at the beginning of the session I know that owing to pressure of many other events he has not been able to write it until recently, and has suffered from ill-health while he has been working on it. In the past fortnight it has been a question of a race against time and the printer for him to get the paper finished. There is special reason for gratification in having the paper, inasmuch as 67 years ago, I think, Mr.

Jevons's distinguished father also gave a paper to the Society. This, so far as I am aware, is the only case of papers being presented to the Society by a father and a son. The fact that Mr. Jevons's father was a pioneer in statistical analysis of the sort which has now come into general use makes it particularly gratifying to welcome the paper this evening.

We must all have recognised the very wide appeal of the paper. I interested myself when reading through it in making a note of the various classes of people to whom it is likely to appeal. These include agriculturalists and astronomers, bankers, economists, engineers, Egyptologists and epidemiologists, mathematicians and meteorologists, physicists, silviculturalists and last the plain business man. It is as a hybrid between a mathematician and a business man that I approach the paper. The fact that any graphical representation of prices or production or any index of trade has more or less cyclical fluctuations is, of course, common knowledge, and at the beginning of the fourth section of his paper Mr. Jevons classifies the theories as to the causes of these cyclical movements under the four headings—psychological, monetary, industrial, and physical. I should like to add a fifth, namely, the operation of pure chance. Mr. Jevons says (p. 565), "The theory which I hold is that the trade cycle is a phenomenon which would continue even if, by some miracle, the harvests throughout the world were to become as certain in their yield as the output of the factory." I am inclined to agree with this because even if the monetary, industrial and physical factors were stable the random variations involved would, when aggregated, produce a cyclical curve. I think that too little regard is paid to the effect of pure chance in explaining trade and business affairs. It is not easy to describe what I mean in general terms, and I will illustrate this point by an example from my own experience. When this country went off the gold standard in September 1931 there was an increase in industrial activity here for a while. In the leather industry there was definitely an increase in consumption and in production, leading for a while to an increase in hide prices. It was recognised at the time that unless other countries increased their demand the increase in prices could not be maintained. There is always a steady weekly supply of hides coming forward in the world and the fact of some increase in consumption in this country without a corresponding increase occurring in the other main countries of consumption, notably America and Germany, is insufficient to maintain a movement. Prices slumped back again and in the curve of prices the movement of September and October 1931 is merely one of those fluctuations which smooth out, and not part of a definite cyclical movement. But in March of this year circumstances in America became very similar to those here in September 1931. She also had a depreciated currency and had developments in trade activity and increased production and consumption. Hide prices rose fairly rapidly. On this occasion, however, almost at the same time events in Germany led to increased demand for leather over there and the equipment of large numbers of unemployed with boots at a time when supplies were small led Germany

to increase her activity in buying hides. By a coincidence which must be ascribed purely to chance, these two events occurred just before Easter, at a time when we in this country were having three or four weeks of exceptionally good weather, and the population here apparently had made up its mind that Easter was to be an open air holiday, and bought boots and shoes on an unprecedented scale. Our own boot manufacturers were rather bare of stocks of leather and this led to an increase in the demand for hides in this country. The three independent events in America, Germany and this country, by happening to synchronise, have caused a very definite movement upward in the market, which appears likely to be maintained, as it has now considerable power behind it, through the increased demand not of a country represented merely by 40 million but by three countries represented in the aggregate by nearly 250 million. Now it is a matter of pure chance that these events happened to synchronise. If they had occurred with a three or six months' interval between them no one of them acting alone would have been sufficient to have maintained prices at a higher level, and the curve of prices would have been a jagged line. Coming together as they did the movement has been great enough to produce a phase of a cyclical movement. This must, I think, be attributed purely to chance. We can conceive of some collusion between Roosevelt and Hitler, although it does not seem within the bounds of practical politics, but it is impossible to assume that anything more than chance brought about these two events just at the time when we had such exceptional weather as to cause our population to spend about £4 or £5 million in shoes instead of spending them in cinemas and other indoor entertainments.

Now that example can be multiplied. We can look upon trade as a whole as being made up of a very large number of factors, each factor varying. If we are dealing with an index which depends upon a large number of factors each of which varies independently of the others, the index as a whole will have cyclical variations. There are also, of course, causes of variation which are common to all the factors, *e.g.* monetary policy, and it is impossible to dissect the data so as to show the effect of each separately. Consider the curve of wholesale prices over the past fifty years or so; this is compounded of a large number of curves representing the movements of individual prices. The cyclical movements of most of the components are more pronounced than the cyclical movements of the resultant curve because of the differences in phase and period. In studying the causes of the variations of the resultant curve it seems essential to consider the variations of the components, and it is then that the effect of chance becomes discernible. It is no answer to this to say that the chance movements when aggregated will cancel out. They will at some times but at others they will be predominantly in the same direction, and for this reason I would add the operation of chance as a fifth factor influencing the trade cycle.

Another point I should like to refer to is that of the question of the accuracy of the data used in describing trade cycles and price movements. Mr. Jevons comments (p. 580) on the discrepancy between the figure of 3·4 years as the period of price

movements and of 3.6 years as the period of solar prominences as requiring further investigation. I believe the price movements dealt with are those based on the Sauerbeck Index and this is far from being an accurate record of actual prices. It is inaccurate as a record of actual prices now and I suspect it was even more so fifty years ago. It is not an index of quotations only, much less of prices at which business is done. Apparently, in the early days of the index the compiler had difficulty in getting price quotations for certain articles and for these articles he used the average value of imports. Although this difficulty has practically disappeared the practice still continues. In a paper given to the Society just ten years ago some measure of the error caused by this was discussed. It was shown that the movement in the index from one month to the next might be as much as 4 points in error by the use of average import prices instead of actual quotations. An illustration was given in which the sequence of the index for three successive months was 135, 131, 135, when as a matter of fact there was no appreciable change in price quotations over the whole period. The point is that the import value will vary from month to month according to the predominant grades imported. Even if the true price is constant the average import value will go up in a month when high grade material predominates and go down when low grade material predominates in the imports. Accordingly, in measuring the period between the peaks of the various movements in the Sauerbeck Index over the past sixty years, it seems to me that there is a possibility of appreciable error in taking them as representing the true interval between price movements. Knowing the deficiencies of the data used I feel that Mr. Jevons would be justified in saying that the 3.4 years period of prices is a satisfactory approximation to the 3.6 years period for solar prominences, but equally a critic on the subject might claim that the error works in the other direction, and that the real difference between the two figures is double that stated by Mr. Jevons.

I have only two other points to mention, without attempting to discuss them. Mr. Jevons says (p. 553), "The characteristic experience is that the prices of manufactured commodities fall more than the prices of raw materials and food-stuffs." Surely this is a mistake. My experience, and I think that of many others, is quite the reverse. The prices of raw materials both rise and fall more than do the prices of the goods made from them, this being the case because the cost of manufacture is more stable than that of the materials themselves. Again, dealing with joint production, Mr. Jevons says, "But the secondary product may, I think, usually be ignored, . . . when we are seeking the cause of trade fluctuations" (p. 567). I do not think this is true at all stages of a cycle. It probably is at the top but certainly not at the bottom. In the last year sometimes secondary products have been more important than the so-called primary products. Millions of sheep, for example, have been destroyed in various parts of the world, and the skin has been marketed as the only portion of commercial value, whereas normally this is only about one-fifteenth of the value of the animal.

I think we can look forward to a very interesting discussion on

the many matters Mr. Jevons has touched upon, and I have much pleasure in formally proposing a vote of thanks.

MR. BARNARD ELLINGER : I notice that Dr. Snow, in enumerating the eleven groups of persons who, he thought, would be interested in this paper, places the business man last. As a business man and in spite of the low position which I thus enjoy I have great pleasure in seconding the vote of thanks to Mr. Stanley Jevons for his exhaustive paper. I also wish to support what Dr. Snow said about Mr. Stanley Jevons's illustrious father, who occupied the Chair of Political Economy at the University in my home town and was President of your senior Society, the Manchester Statistical Society, to which he contributed many papers of outstanding interest.

I wish to use the time at my disposal by asking Mr. Jevons if he will enlighten us further on two points.

Mr. Jevons says that trade is prosperous when there are large crops, even if they have to be sold at low prices, provided that the crops are sold and are not hoarded. He then tells us that the elasticity of demand for certain products, *e.g.* wheat, is very low. What is to happen when the world has enormous wheat crops; much greater than the world's requirements? How is the farmer to get rid of the surplus? If he does not hoard will he not be forced to reduce the price to a level at which the total amount of money he receives for his superabundant crop is less than the normal amount he receives for a normal crop? Will that not result in trade depression? It will lead to a dislocation of production, for the people who benefit from the low prices will not spend their surplus on the same things which the farmers buy.

Mr. Jevons then tells us that the elasticity of demand for cotton is high. I wish economists and statisticians would turn their attention to giving business men some real lead on this question of elasticity of demand. There is a considerable amount of confused thinking on the matter because the elasticity of speculative demand is much greater than the elasticity of consumers' demand. The piling up of stocks when prices are low often leads people to imagine that the low prices have increased the demand of the consumer to a far greater extent than is really the case. It seems to me that we cannot make general statements and say, *e.g.*, that the elasticity of demand for wheat is low and for cotton high. It depends in the first place on the period of which we are talking, and the standard of living which has been reached. I imagine that even two or three decades ago the elasticity of demand for wheat was much higher than to-day. I believe that the degree of elasticity in the demand for cotton is far less than is generally supposed. It may be fairly high for the cotton which is used in making a *dhoty* for the Indian ryot but it is very low for the raw material which goes into our shirts, and practically nil for the cotton which is being used in ever increasing quantities for motor tyres, insulating cables, etc. In all cotton goods, as we increase our standard of living we put more labour into the finished product, and as the proportion of value of the raw cotton to the total value

of the manufactured goods declines the elasticity of demand for the raw product decreases. This must also apply in greater or less measure to other classes of commodities. I feel sure that if we had more light on the whole question it would be of the greatest use both to the raw material producers and to the business man.

My second point is this: Mr. Jevons says that "industrial and monetary causes must be clearly distinguished." The ordinary layman is, I think, quite incapable of distinguishing between industrial and monetary causes of the fluctuations of the general price level. We are taught that it is the relationship between the amount of money which people are willing and able to spend at any given moment and the amount of commodities which they are willing and able to sell at the same time which affects the general price level. Mr. Jevons tells us that new inventions, etc. are non-monetary causes of the reduction of the general price level. Whatever alteration may take place in the price level will be due to a disturbance in the relationship between the amount of spendable money and the amount of commodities offered for sale. The layman suspects that if the alteration in the relationship is initiated by an alteration in the volume of commodities produced it is called "non-monetary," but if it initiates an alteration in the amount of spendable money it is called a "monetary" cause. It appears to him that both are due to an alteration in the relationship between money and commodities.

DR. C. E. P. BROOKS said he had listened to Mr. Jevons's paper with great interest, the more so as he had long ago been interested in his father's well-known theory. There was no doubt at all that the sun influenced the world's weather and that there were cycles of solar activity. It therefore appeared obvious that there must be some dominant solar cycles of weather, and presumably of crops. Unfortunately, however, the matter was far more complicated than that. The world was an extremely complicated engine, and where one part was speeded up, others were retarded, and it was only in a few cases that a definite relationship could be found. The rainfall of Europe went through a $5\frac{1}{2}$ year cycle, the reason being apparently that the sun's activity not only affected central Europe directly, but also had to travel up from the tropical regions. The cycle was therefore disturbed and irregular. In the same way, the sun's heat melted ice in the polar regions, and it was not for two or three years that the cold water from that melting ice got into the Atlantic Ocean and affected European weather.

There did appear to be two things in which the sun's effect could be clearly recognised, one being the rainfall of the great plains far away from the sea, such as Central Siberia and Central Africa. In Central Siberia the correlation between sunspots and thunderstorms, which bring the summer rainfall to over 0.8. The other relationship to sunspots was in the number and distribution of storms, and there he would like to add one more to Mr. Jevons's causes. It had been shown, for example by Huntington, that variations of weather affected human energy, especially variations of storminess. If storminess had a close relationship to the

solar cycle, and did affect energy, that had an important bearing upon the cycle of business and trade.

MR. R. GLENDAY congratulated Mr. Jevons on his interesting paper, and in particular for laying stress upon what he had called the *real* causes of the trade cycle. His own feeling about *monetary* explanations of the trade cycle, such as given, for example, by Mr. R. G. Hawtrey in his *Currency and Credit* was that though doubtless they were perfectly correct they did not take one very far. He submitted that it was wrong to believe that monetary explanations of the trade cycles disposed of the need of looking for explanations on the production side, or, alternatively, that the acceptance of a non-monetary explanation pre-supposed a rejection of the monetary one. Monetary and non-monetary explanations were, he submitted, different aspects of a single economic reality—trade. To adapt the analogy of a living organism, money might be said to behave in commerce in the same way as the “blood stream” in the human body. It co-ordinated the activities of the separate parts, transferred products and stimuli from one part to another, and, in general, was part of the mechanism by which the industrial system as a whole adjusted itself to changes both in external environment and within its own structure. If a man had his arm blown off we could, following Mr. Hawtrey, describe his condition solely in terms of the consequential reactions on his blood supply and say that he is suffering from a severe dose of blood “deflation.” But doctors who had to treat him would find it useful to know that this “deflation” had been caused by the loss of an arm! In the same way, those who desired to prevent or cure trade cycle fluctuations would find it useful to know whether the credit cycle associated with any particular trade cycle was set going by such things as, say, a new supply of gold, a war, a new invention or a harvest fluctuation of the type described in the paper.

Mr. Jevons had suggested that harvest fluctuations produced trade fluctuations by their *immediate* effects on the ability of agriculturalists to buy the products of industry. But Mr. Glenday would like to suggest to him that, via the money supply, they might also produce industrial fluctuations *at one remove* as follows: Textiles and grain made far and away the largest demands on the quantum of bank credit. Suppose that at a time when owing to a bad harvest the credit demands of textiles and grain became subnormal, and that while this was happening a boom in industrial investment got under way in response to the stimulus of, say, a new invention or the discovery of a new market, then it would be natural to anticipate that these “industrial” developments would mop up the surplus quota of bank credit left over by agriculture. Next, let us assume that a year or two later when the industrial boom had got well under way a bountiful harvest comes along with a consequent increased demand by agriculture for bank credit—possibly even beyond the original quota, and, as was likely, that industry was reluctant to release Bank credit for the purpose. Under such circumstances the banks might be driven to raise the

bank rate to a crisis level in order to *force* industry to release part of its quota.

In connection with the problem of trade cycle phenomena generally, Mr. Glenday felt that it might be more useful if we stopped trying to discover a common explanation or a typical cycle which would fit all occasions, and concentrated on examining the various types of cycle which were known to occur in close association with such *real* phenomena as harvest fluctuations, new gold discoveries, new inventions, etc. In a paper read before the Society in November 1931 on "Trade Forecasting and the Influence of Money on Trade Development," he had drawn attention to fluctuations associated with changes in the rate of trade growth itself which certainly had no obvious direct connection with either Mr. Hawtrey's credit cycles or Mr. Jevons's crop cycles. He might mention two, the first caused an abrupt break in trade growth in 1874, and the second in 1902. He was hoping to publish further details shortly. His reason for mentioning this work was that it supported Mr. Jevons's view that examining the real causes of trade cycle phenomena was likely to result in the discovery of valuable practical information.

MR. R. G. HAWTREY said he had listened with very great interest to Mr. Jevons's paper, which he found extremely suggestive. There were one or two points to which he would like to refer.

In the list of trade cycles and their respective lengths on p. 561, it seemed that there were several points on which there was at any rate room for a difference of opinion, as to when or where the trade maximum occurred. In the first place, going back to the eighteenth century, Mr. Jevons gave the series of trade maxima as 1770, 1783, 1796, and 1800. With regard to 1770, there was a financial crisis in 1773, which Mr. Hawtrey had always supposed came at the culmination of the cycle. He might be wrong, but it was a surprise to him to find 1770 specified as a maximum. There was no doubt whatever that there was a trade maximum in 1793. It happened to coincide with the outbreak of war, but the phenomenon of the crisis was perfectly clear, and there was an undoubted setback in trade following that. In the war period that followed there was some confusion of the cycle. He would not dispute 1796 being a maximum, but he thought there was just as good evidence for finding maxima in 1804 and 1814 as in the other years chosen. That was due to the confusion arising out of the war and particularly the inflationary methods accompanying war.

Then, in the 'thirties, the trade maximum, as distinguished from the financial crisis, occurred rather in 1836 than 1839. There was clear evidence of a reaction of trade in 1837 associated with the crisis of that year, of which the financial crisis of 1839 was merely a later development. It was doubtful whether 1880 was properly specified as a trade maximum; there was more to be said for 1882.

Finally Mr. Jevons himself pointed out that the year 1914 was a year of reaction, and it was quite clear that the trade maximum occurred in 1912, although it was not associated either with any

financial crisis or with extremely dear money. In that case also there followed a period of confusion owing to war, so that although there was a maximum in 1920, that was rather a riot of inflation, extending even to those countries remaining on the gold standard, than a normal trade maximum.

With regard to the secular movements of prices, Mr. Hawtrey would entirely agree that there might have been a fall of prices owing to a fall of real costs during the periods of secular fall, but he could not agree that any industrial explanation would account for the secular rise between 1896 and 1914 or between 1849 and 1873. The only conceivable explanation of the rise of prices in those two periods was the monetary one. He noticed that Mr. Jevons attached more importance to the monetary causes as an explanation of the secular rise than to the cyclical. If one asked what the cycle was, it was a cyclical movement of productive activity. The movement of productive activity was undoubtedly closely associated with fluctuations of the price level, but the striking thing about the cycle was that the maximum of the price level came at the same time as the maximum of activity, and the minimum at the same time as the minimum, so that the total flow of money from consumers varied in a proportion compounded of the fluctuation of productive activity and of prices. The essence of the monetary cycle was that the changes in activity and price level were associated with these changes in the flow of monetary tokens. When the Banks loosened credit they enlarged the consumers' outlay.

If reference were made to the experience of the nineteenth century, it would be found that invariably at the time of maximum activity a shortage of currency made itself felt. Because there was a shortage of currency, the Banks restricted credit, the purpose being to compress the consumers' income and make the demand for commodities less than it had been. There was a direct connection between the action of the Banks and trade activity.

Those who believed in a physical explanation of the trade cycle claimed that that activity was associated with a variation in the yield of crops and natural products generally. The first thing to ascertain was whether the increase of the output of natural products caused an increase of activity or a diminution. The answer undoubtedly was that it could cause *both*. The outcome depended upon such matters as the elasticity of demand; but when one asked what the elasticity of demand was, nobody knew; it depended upon circumstances.

Exactly what effect any particular state of the weather was likely to have upon trade activity was a matter on which no light had yet been thrown by any of the advocates of the physical explanation of the cycle. Mr. Jevons was inclined to rely rather on an empirical argument. Starting from the established fact of the existence of weather cycles, he would infer that they were likely to cause corresponding cycles in the output of natural products. If he had established a very close coincidence between the period of the trade cycle and the meteorological periods, that undoubtedly would have been a contribution towards making out the case.

But Mr. Hawtrey did not think any correspondence of that kind, even if demonstrated, could very well be decisive without theoretical support. And one found an infinite variety of periods, while Mr. Jevons did not even state what phase of the period he favoured had been reached at any particular moment. How was his theory to be tested? It was impossible to know, for example, whether the present state of his $3\frac{1}{2}$ year cycle was one associated with the highest degree of activity or with depression. The empirical evidence was enormously less cogent than Mr. Jevons was inclined to suppose.

MR. A. PROVEN said that one speaker had mentioned that there were several types of people. He was a guest, and happened to be a chemist, and as such he approached the subject from an exact scientific point of view. The first thing he noticed in the paper was the table on p. 561 showing the dates of maxima of trade cycles. When he looked at the intervals of the years he was immediately driven to the conclusion that there was no such thing as a trade cycle, but merely an irregularity. By a "cycle" he understood a fairly definite periodicity, and of that there was no evidence. It might be said to be something like what happened in the compound pendulum, and by applying analysis and combining the different causes one might arrive at this rather irregular cyclic wave. That had been done in the case of the compound pendulum and the tides, but in those cases each of the causes had a definite period and the mathematical combination was brought about by a fundamentally simple process of L.C.M. and H.C.F. in ordinary arithmetic. That principle could not be applied unless the figures were absolutely definite, and in his opinion, this paper did not belong to exact statistics at all. There was another kind of cycle or periodicity which was not mathematical, known as the periodic law in chemistry. When first discovered it was an empirical law and, although empirical, it allowed forecasts to be made of missing elements without any mathematical basis. Here again the trade fluctuation gave no evidence of a periodicity even of that kind. It was impossible to foretell what would happen next year as a result of the study of all previous trade fluctuations, and therefore this matter did not seem to be approachable, from the point of view of exact science, from the quantitative aspect.

Dr. Snow had said there were additional causes present which he called chance causes, but Dr. Snow was sufficient of a determinist to mean really "other causes." The complex of causes was so great that any attempt to apply the principle of periodicity broke down; it was a problem too complicated to be attacked by statistical methods.

There were two kinds of economists—institutionalists, and ordinary economists who proceeded by ordinary methods of logic, and these rather old-fashioned people had the advantage here. The institutionalists had not been able to forecast the present slump, but it was forecast with Dr. Hayek's help, for the Austrian Institut für Konjunkturforschung, from the Harvard chart. The work of the Austrian School of economists was, in his opinion,

the first really promising attempt to get any sort of generality into the study of the trade cycle. When the passage of an economic system through time was brought into account, the problems arose of the balance of production and consumption for the future against the same things for the present. This was now being developed by the Austrian School, and it was unfortunate that the valuable contribution being made by that School had not been mentioned.

The following comments were received in writing after the meeting.

SIR NAPIER SHAW, who was unfortunately prevented by illness from attending wrote: I am interested to see that Professor Jevons is taking up again the question of the succession of the yields of crops in relation to periodicity and sunspots, and I note that he refers to some work of mine on an eleven years' period in the yield of wheat in England which formed the subject of a paper in the Hann Band of the *Meteorologische Zeitschrift* in 1906 and another in the *Journal of Agricultural Science* of 1907. They dealt with the yields of wheat in England East, as estimated by the Board of Agriculture, in the 21 years 1885 to 1905. I made some attempt to pursue the subject further in reprinting the second paper in *The Air and Its Ways*, Cambridge Press, 1923; but the methods of estimating crops were altered and I finally lost myself in the impossibility of evaluating hundredweights in terms of bushels of wheat.

I should like to say that the periodicity indicated by the yield of wheat in those 21 years is of a different kind from that of others of the set of about 200 periods between one year and 260 years in the sequence of meteorological phenomena as set out in Vol. II of my *Manual of Meteorology*. The periodicity of the wheat yields is unique because it was detected not by the numerical combination of groups of values for the prescribed period, in the way of an ordinary periodogram, but by the recognition of the recurrence of the same individual values after eleven years and the progressive reproduction of the original sequence by bringing in successive harmonic components, so that the phenomena seemed to indicate the concurrence of real components in a node in 1895-6 and consequent reversal of the values on the two sides of that epoch. The same kind of behaviour in meteorological sequence is studied at Leipzig, though it does not commend itself to English mathematicians.

And, indeed, it is rather amazing when we consider that this remarkable periodicity is indicated not for the weighed crops of a single field, but for the roughly estimated crops of a group of counties comprising fields of many different kinds of soil and treatment. The two aspects must have their differences. Perhaps on that very account the single value for the whole year turns out to be one of nature's integrations inimitable by the mathematician's skill. If anybody likes to say that the behaviour of that group of 21 years is pure chance I should require a little time to think before contradicting him, and yet the chance that the yield for 1907 should

be predicted as 35.3 in 1905 and turn out to be exactly that in 1907 must be rather remote. There must be something more in it than pure chance. And, moreover, the singularity is less surprising if we allow that the passing years must spoil the concurrence of the components in a node, if the fundamental period is not exactly eleven years. My happening upon that concurrence is certainly chance. It would be most instructive to know when it happened last and when it will happen again.

So I would gladly support Professor Jevons's contention that more provision than exists at present should be made for the pursuit of scientific questions of that kind. And yet, in my opinion, they are too delicate to be pursued with the hammer and tongs of *ad hoc* official routine. They are rather the side issues of a division or intelligence department devoted to the meteorological service of agriculture, so arranged that routine might keep its swing while research was getting on with that unconscious integration which means success.

DR. M. J. ELSAS wrote : In regard to the very interesting paper which Professor Jevons read, I should agree that the influence of crops on industrial activity is still great, even though it often differs from that of earlier times. It seems to me that the overwhelming significance now lies more in the distribution of income between agricultural and non-agricultural producers. But to work out a differential formula for this purpose would be very difficult, as the external data, which generally predominate over the internal data, make it highly complicated.

In earlier times formulæ were compiled for the purpose of showing how a scarcity of crops, of various percentages, increased the price-level, needless to say in geometrical ratio. As the price-level is influenced not only by the last but also by the previous crops, such a formula has only a retrospective value. But up to now nobody has, so far as I know, tried to compile even retrospectively a formula showing how over-production influences the price-level of grain.

Some scientists, who base their theories on the solar theory, have, I think, gone too far. I would especially refer to an essay of Strakosch-Grassmann : "Die 242-jährige Periode in der klimatischen Geschichte Deutschlands."

MR. JEVONS, in reply, said : I should like to thank you for the vote of thanks which has been so kindly given to me, and to thank Dr. Snow for his kind references to my father and to myself.

Dr. Snow brought forward the question of chance. Nothing in my paper tended to exclude such causes. I mentioned them more than once; but, whilst admitting that the aggregate effect of unrelated causes on the price of an individual commodity may be considerable, I should say that it would be extremely unlikely that the sum-total of these fortuitous causes would put the prices of almost all commodities through a cycle affecting all countries nearly simultaneously. It was really with the object of finding something which could operate throughout the whole world and on all com-

modities at the same time that I have been in search of physical causes. Dr. Snow did not consider the data to be sufficiently good to distinguish between 3·4 and 3·6 years as the average length of the minor trade cycle, and that it was unnecessary to worry about the difference. I should not have spent years worrying about this difference if I had not thought the dates were sufficiently accurate.

In reply to Mr. Hawtrey I may say that in fixing the dates of cycles historically I relied not so much upon prices as upon the volume of trade as shown by foreign trade returns of the eighteenth century. The data on which I relied are dealt with in my first appendix. I endeavoured to get all available statistics bearing on trade activity and the price-level, and to combine them in order to fix which were the years of maximum activity. I admit that here and there there may be grounds for differences of opinion, and Mr. Hawtrey may have a good argument that certain cycles should begin or end with a different year as maximum. As regards the difference between 3·4 and 3·6 years, I think I was perfectly able to distinguish the number of the minor cycles [namely 62] within a definite period of years [1695–1907].

I expected the criticism that I was wrong in stating that prices of manufactured articles had fallen more than those of agricultural and other primary products. I did not mean that during the past few years the prices of manufactured articles in general use, such as are selected for index-numbers, had fallen more than those of primary products; but was referring to the fall of the price of an article from its first invention, or from the first application of machinery to its production. In the case of a great many manufactured articles now in everyday use, owing to the initiation of improvements in their manufacture, a very considerable fall of price has taken place. Compare, for instance, the present price of bicycles with their cost when first put upon the market; or of vacuum flasks or electric lamp bulbs.

I regret that there is not time for me to reply in full now to the various points raised in the discussion; but I shall avail myself of the opportunity of doing so in the *Journal*.

Mr. Jevons afterwards sent the following remarks in writing :

My reply at the conclusion of the discussion to the observations of Dr. Snow needs amplification on three points. As regards inaccuracies in the Sauerbeck index-number, certainly I have relied on it to give the years of maxima of the general price-level, without having inquired as to possible inaccuracies; but I find it hard to believe that such inaccuracies as there are could produce an aggregate effect sufficient to change the year of maximum price-level. Moreover, the years of booms of trade passing into collapses are supported by quite other data covering most of the nineteenth-century, especially statistics of foreign trade and production.

In regard to the fall of the prices of manufactured products being greater than that of agricultural and primary products generally, if we compare the prices of many modern articles now with the prices in, say, 1913 of styles and qualities as nearly comparable as possible,

we find that all have fallen substantially. The prices of motor-cars, for instance, have fallen from £200 to £145, or from £450 to £240; those of bicycles from £15 to £11; of thermos flasks from 21s. to 5s. 6d., of metal filament lamps from 4s. 6d. to 1s. 9d., of artificial silk from, say, 6s. a yard to 2s. Going back to 1900 the fall is greater, not less, as with agricultural products and minerals. The same sort of thing was happening a hundred years ago as regards many staple iron and steel products and machinery, and had happened a few decades earlier in cotton yarns and cloths.

With regard to joint products, Dr. Snow is, of course, right in saying that in certain countries at certain times the most important of the joint products of an industry, from the point of view of average value in previous years, may become replaced by another of the joint products as that which gives the best return; but, taking the world as a whole over a long period, I cannot see that the omission of what are normally products of minor importance is likely to cause a general index-number of production of agricultural produce, or primary products in general, to vary from the truth by an appreciable amount, especially when the object is to fix the years of maximum production of all primary commodities taken together.

Mr. Ellinger has asked what the farmers are to do when the world has enormous wheat crops. The present superabundance of wheat is, I think, unprecedented, and is due mainly to the wide adoption of tractors and the combine harvester. I agree that a big crop, if held up, must tend to produce trade depression; and, if marketed, some dislocation of industrial production.

I made merely a passing reference to the elasticity of demand for cotton, which Mr. Ellinger says is low, not high. The truth is, I think, that the elasticity of demand for raw cotton is low in the short period, but fairly high in the long period. I entirely agree with Mr. Ellinger's statements about the elasticity of demand for cotton being fairly high for the Indian ryot and low for that which goes into European clothing; though it is not so low for that which is made into sheets, towels, etc.

In regard to my emphasis on the distinction between industrial and monetary causes, Mr. Ellinger's "layman" is very nearly right. If the alteration in the volume of commodities produced is due to new inventions, or investment of capital in new plants, attracted by expected high profits, these are non-monetary causes, because the first or independent cause is the invention, or the provision of additional fixed capital. Of course the industrial causes work through the marketing and money mechanism, and only so have their effect on price. The monetary causes of a changed relationship between commodities and money are mainly an alteration in short-term credit and spendable money.

I have only to thank Dr. C. E. P. Brooks cordially for his remarks on weather cycles, and for calling my attention to the very high correlation between sunspots and thunderstorms in Siberia. I was aware of Prof. Ellsworth Huntington's theory that human energy is greatest in land areas where storminess is most frequent, and of the suggestion that such a variation in accordance with

climatic differences may occur, not only geographically, but in time. I am not aware, however, that there is evidence discovered of the direct dependence of the psychological state of business men, and the efficiency of manual workers, on major weather changes or climatic differences from year to year. I felt indisposed, therefore, to mention the hypothesis, though I knew it was under investigation in the United States.

With much that Mr. Glenday said I heartily agree; and I endorse his observation that fluctuations of harvests tend to produce fluctuations of industry, at one remove, through their influence on bank credit: indeed I mentioned one way in which this occurs. Mr. Glenday's outline of a way in which bank credit may be affected by harvests is, however, I think, open to one criticism. He does not say how a boom of investment could get under way in a year (I must assume he meant) of bad harvests in the principal crop-growing countries. A new invention, or the opening of a new market, is not likely, it seems to me, within any two or three years, to make such sudden progress as to be responsible for initiating the expansion phase of the trade cycle, much less the boom. It seems to me that the important point about the rate of interest (or discount) is that it is raised as a check on undue expansion and speculation during a period of marked trade activity. A year or so later, perhaps after a period of less stringency, it has to be raised still higher in the endeavour to force merchants and manufacturers to release credit; and this later or second rise always takes place soon after the growth of stocks in the hands of both these latter classes (and consequent absorption of bank credit) as the result of imports and production outstripping consumers' demand at the prevailing high prices.

The extent to which secular changes, such as the rate of trade growth, transportation facilities, etc., may at some periods have a strong influence on the trade cycle, as suggested by Mr. Glenday in his paper read in November, 1931, on "Trade Forecasting and the Influence of Money on Trade Development," is a subject which needs investigation. Was not the abrupt break in trade growth in 1874, which he mentions, due mainly to the slump, which was the beginning of a trade cycle and of a period of secular fall of the price-level which commenced then; and were not the slump and the continued fall of the price-level alike due to both industrial and monetary causes?

Mr. Hawtrey's criticisms of some of my dates for the trade cycles are valuable. In choosing 1839 rather than 1836 as the end of the cycle which began in 1825, I was influenced by the fact that the index-numbers of prices computed by my father give a distinctly higher figure for 1839 (92) than for 1836 (86). Starting with 1833 and ending with 1842 his index-numbers are: 75, 78, 80, 86, 84, 84, 92, 87, 85, 75. Sauerbeck's index-numbers for the same years, however, give a distinct maximum at 1836, and the figure for 1839 is about the same. Other financial and economic data indicate 1836 as a year of moderate boom followed by collapse. I therefore accept Mr. Hawtrey's correction. This has the satisfactory result of giving two 11-year cycles (1825-36 and 1836-47) in place of one of 14 years followed by one of 8 years.

I have carefully considered Mr. Hawtrey's other suggestions for correcting the dates I have given; but in most cases I think the dates he proposes are at least as much open to question as mine. There is, in fact, a real difficulty in deciding on the beginning and end of several of the trade cycles, which arises whenever the minor trade cycle becomes pronounced. The difference between 1836 and 1839 is one minor cycle, and so is the difference between 1880 and 1883, and between 1793 and 1796.

Mr. Hawtrey has suggested that 1882 should properly be specified as a trade maximum rather than 1880, and Mr. Joseph Kitchin in his comprehensive chart adopted 1882. Although wholesale prices and the total of foreign trade reached a maximum in 1880, I am inclined to agree with Mr. Hawtrey that 1880 is not a true year of maximum. On reconsideration I regard 1883, which was the year when the recession commenced in the United States, as the end of the trade cycle starting with 1873. The year 1883 is preferable to 1882, for our foreign trade reached a maximum in the former, and unemployment remained at its lowest, wages almost at their highest, whilst prices, according to Sauerbeck's index-number, remained at about the same level *relatively to the secular trend*, which was downward. The fact that the *average* market rate of discount for the whole year 1883 was a little lower than in the preceding year is not inconsistent with choosing 1883, because the activity of trade was not sustained for the whole of the year.

Mr. Hawtrey has questioned my date 1770 for a trade maximum, and thinks that 1793, 1804, and 1814 also were years of trade maxima. There was a crisis in 1772-3; and, after further investigation, relying partly on the official returns of foreign trade of England, I think 1772 is the correct date for this maximum. So did my father, who gives 1772, 1783, 1793, and others, in his paper on "The Periodicity of Commercial Crises" written in 1875.* As regards 1793, I have not been able to convince myself that the trade activity of that year was important enough to be regarded as the end of the trade cycle, nor did a collapse begin then. The year 1804 was one of mild crisis; and there was a crisis also in 1801, often ascribed to the conclusion of peace. Owing to the war, these are difficult years to interpret, but I think 1800 should remain.

As regards 1914, my reference to it (see end of § IV, p. 565) was "that the maximum of trade activity had already been reached and passed a few months before the outbreak of the Great War." By a few months I meant four or five months. It was the year in which the impending collapse was starting, after the active trade of 1912-13, continued in the first half of 1914; and so, on the plan I have adopted, 1914 is the correct year of maximum for dating the trade cycle. It has to be remembered that the figures of trade and production for 1914 were considerably reduced by the war, which immediately dislocated foreign trade. Some people regard 1913 as a year of maximum, and Mr. Kitchin calls it a year of "semi-crisis." A rather high rate of discount is, however, the accom-

* Reprinted in "Investigations in Currency and Finance." 1st ed., 1884.

paniment of very active trade and speculation, and is not a crisis at all in the true sense. Crises occur (apart from war) when merchants and manufacturers are extensively embarrassed by a fall of prices which has already taken place. Though Mr. Hawtrey is right in saying that trade was active in 1912, 1914 was the year when maximum activity passed into recession.

The changes which Mr. Hawtrey has suggested for the dates of trade maxima, and I have accepted, alter the frequency distribution of the lengths of cycles given on p. 561 as follows :—

Duration in years	4	5	6	7	8	9	10	11	12	13	14	15
Number of Cycles	2	0	0	5	1	4	8	6	0	2	0	0

That monetary changes were the main causes of the secular rises of prices from 1849 to 1873 and from 1896 to 1914 was stated in my paper (pp. 555, 558). Mr. Hawtrey's observation that banks restrict credit at the time of maximum activity on account of an actual shortage of currency is doubtless true, since they have learnt to be cautious; but, if the central bank of the country has an elastic issue, the need of credit restriction is lessened or deferred, and there may be no such action sufficient to arrest the rise of prices.

When Mr. Hawtrey complained that "Exactly what effect any particular state of the weather was likely to have upon trade activity was a matter on which no light had yet been thrown by any of the advocates of the physical explanation of the cycle," he made no attempt to indicate the full scope of my theory in all its complexity—perhaps he had hardly envisaged it himself. A great deal of research has been done in recent years on the influence of weather conditions on each of the staple crops before sowing and during growth. The effects on ripening and harvesting have, of course, been known for a long time.

The climatic character of each year varies in one or more of the weather cycles which have been referred to in my paper; and it has been well known for a long time that a hot dry year produces drought in the interior of the continents—thus a failure of crops—and causes depression of trade, as explained in my paper (pp. 564, 578). The response of wheat and cotton to weather conditions is, however, being profoundly modified by the breeding of new varieties suitable to dry or to moist or cold climates. The cultivable area may not only thus be greatly extended: it is probable that a less fluctuating yield will be secured on the average of the great agricultural countries of the world when they have adopted for the most part such improved varieties.

Mr. Hawtrey is dissatisfied with the degree of correspondence which I have found between trade cycles and meteorological cycles. Other speakers, however, have regarded the correspondence between the minor trade cycle and those weather cycles which I have shown to be of approximately the same length as being as close as one could expect from the data. I did, in fact, deal with this point towards the end of my paper (p. 580).

Finally, Mr. Hawtrey said: "Mr. Jevons did not even state what phase of the period he favoured had been reached at any

particular moment." I do not "favour" a cycle, but endeavour to marshal evidence that one exists. Assuming that the speaker had in mind the minor trade cycle, I would refer him to p. 563, where I stated that the minor cycle may be dated in recent years, and gave the dates of maximum trade activity in U.S.A. That which occurred in the winter of 1925-26 was followed by the maximum of 1929. The next maxima of the minor trade cycle are probably due in 1933, 1937 and 1940. I give 1933 because 1932 certainly was not a maximum; and because it is strongly indicated by the peculiar interval of 13 years covering a group of minor cycles which so frequently recurs; *e.g.*; 1890-1903, or 1907-1920.

Pursuing another method, we may take the average period of the minor trade cycle, which in recent decades has been about 3.35 years (14 cycles from 1873 to 1920), and project it from 1920. Three minor cycles carry us to 1930, in which year the boom and beginning of the collapse should have occurred; and four minor cycles bring us to 1920+13.4, which may, I think, be interpreted as 1933, though I do not know what the exact phase was in fractions of a year in 1920. The later maxima would seem to be clearly indicated for 1937 and 1940; but which of them will end the present trade cycle I cannot say. It may depend on monetary causes; but the fact that we are in a seculum of falling price-level suggests 10 or 11 years for the present cycle. If we assume that the collapse of 1929 came a year too early, being precipitated by the immense over-production, especially of primary commodities, we may observe that the minor trade cycles from 1920 to 1940 will, if my forecast prove correct, have the following duration successively in years: 3, 3, 4, 3, 4, 3. This satisfies the natural condition, if a physical cause with periodicity of about $3\frac{1}{3}$ years does time them, that two 4-year cycles will not follow one another.

Mr. Hawtrey naturally would like to know in what phase is the agricultural cycle which is supposed to generate these minor trade cycles. I am sorry I cannot tell him. The present year appears to be a hot dry one throughout the world; and, judging from recent harvest forecasts, it seems as though the harvests of the great continental countries will be poor, and those of the coastal regions, including Great Britain, will be good (*cf.* p. 578 above). However, until someone decides whether crops are obeying primarily the 3.2 or 3.66-year weather cycles, or which of them is the predominant cycle in the principal crop-exporting countries, if both are operative, but in different areas, I cannot see that there is much object in trying to determine the present phase. This must wait for a much more comprehensive investigation than I have been able to undertake. My intention has been in this paper to open up lines of research which I hope many other workers will follow.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society :—

Victor Harold Burraston, B.Com., F.C.R.A.
 Arthur Ethell, F.I.S.A., A.C.P.A.
 S. Sundaresan, M.A. (Rangoon).

THE MEASUREMENT OF PRICE CHANGES : RETROSPECT AND PROSPECT.

By A. W. FLUX, C.B., M.A.

[Read before the Royal Statistical Society, June 20th, 1933, the President, the R.R. HON. LORD MESTON OF AGRA AND DUNOTTAR, K.C.S.I., LL.D., in the Chair.]

It is now more than twelve years since I had the honour to lay before this Society a plan for a new series of index-numbers of wholesale prices then in course of preparation at the Board of Trade. Apart from some suggestions that, in a series of calculations intended for use by the general public, the employment of the geometric mean, as proposed, might be deemed inexpedient, as not readily understood, little, if any, complaint as to the structure of the new index-numbers has been made. The balance between the different sections of the index would appear to have approved itself to other workers in this field. In reconstructing its monthly index of prices our greatest daily newspaper adopted a plan so nearly parallel in its distribution of emphasis, having regard to the different degree of detail utilised, that it would appear reasonable to conclude that the data gathered were consilient with those accepted for use in the Board of Trade Index. A former member of our Council, who furnishes to another leading daily an independent series of calculations, has similarly indicated his agreement with the plan laid before you in January, 1921.

That plan has now been tested by experience, and the fourteenth of the post-war years for which the monthly index has been calculated is now well advanced. As was indicated in the original plan, the intention to keep the Index-Number in touch with the changing conditions of the community, to whose business it is intended to relate, was a vital part of the scheme. So far as concerns the substitution, for a source of information that no longer furnished representative data with the desired regularity, of other data reflecting price movements in the same industrial field, the use of the geometric mean has facilitated useful change.* It is a class of change that must affect all price index-numbers in some degree, so that the Board of Trade Index has only shared with other like indices the results of changes in the data available for the calculations. The special point aimed at in the plan of this Index-Number, namely, the utilisation of new data, becoming available at more or less regular intervals, to maintain the balance of the Index-Number, so as to correspond with

* A list of the changes made is given in Appendix III.

changes in the national industrial and commercial structure, has not, however, found expression in the actual working out of the monthly figures up to the present. It was necessary, working in 1921, to make use of the only complete survey of British industrial—including agricultural—activity then available, namely, that resulting from the First Census of Production, and relating to 1907. It was clearly realized that, in the fourteen years that had elapsed, changes of great importance had taken place, which ought to be reflected in the structure of the Index-Number. Effect was, in fact, given to known changes in determining the place of petroleum in the scheme, by way of exception to the principle generally followed. There was some hope that, work on the Census of 1912 having been interrupted by the War, a new Census might be found possible at an early date. Orders made by the Board of Trade were, however, withdrawn before the expiration of the statutory interval, and when the Third Census, that relating to 1924, was finally taken, the working up of the results could not be pressed forward rapidly in the face of repeated spasms of economy and a continued pressure of urgent work of other kinds. Not until the spring of last year was the last of the volumes of the Report issued, while no general survey on the pattern of the introduction to the earlier Report was issued on this occasion. The completion of the final data for individual trades has, however, rendered possible a calculation on lines approximately parallel to those adopted in preparing the scheme of the Index-Number in 1921. The deviations from that scheme are not of any serious importance so far as I am able to judge, aided by the competent criticism of my principal collaborator in the preparation of the original scheme of distribution of the data to be used, Mr. Macrosty.

The following table gives a brief summary and comparison of the distribution of what, for brevity, I will refer to as the "weighting"

	Original Distribution (1907).	Distribution for 1921.
(i) Cereals	17	17
(ii) Meat and Fish	17	15
(iii) Other Food and Tobacco	19	20
Total of (i) to (iii)	53	52
(iv) Iron and Steel	24	25
(v) Other Metals and Minerals	20	15
(vi) Cotton	16	14
(vii) Other Textiles	15	18
(viii) Other Articles	22	26
Total of (iv) to (viii)	97	98
All Articles	150	150

of the original Index-Number and that which appears to be appropriate to a community such as was ours in 1924, according to the principles of the scheme of 1921.

The changes shown in this table, and in the fuller detail given in Appendix I to this paper (p. 620), are partly the result of changes in the quantities of goods of the various classes produced and consumed in the United Kingdom. The difference between the territorial extent of the United Kingdom, in 1907 and 1921 on the one hand, and in 1924 on the other, is not without its importance, since the industry and trade of the Irish Free State are not exact reflexions of those of the United Kingdom. The differences between the price structure of 1907 and that of 1924 are also important. To base the calculation of an index-number relating to post-war variations on data drawn from a pre-war period would appear to be capable of producing curious and possibly undesired results. In fact, however, the changes due to price variations are not the most important of those which it is necessary to take into account, so far as the available information shows.

The data have not been found which would enable the present Index-Number to be carried back to 1907. A satisfactory calculation is, thus, not possible of the degree in which the divergences between the new and the old schemes of weighting may be attributed to a changed price structure on the one hand and on the other to changes in the quantities of goods of the various kinds the exchange of which was effected by the use of money at the two epochs. The comparison of 1913 with 1924 can be made, but that of 1907 with 1924, if made, must be made on a basis far from identical with that which can be used for the 1913-24 comparison. I have attempted to utilize such data as those regularly published in our journal, relating to the Sauerbeck Index-Number, to secure a rough estimate of the extent of the price movements, between 1907 and 1913, in the various groups of commodities for which separate calculations have been maintained in the Board of Trade published data. The results are sufficiently interesting to warrant a brief reference.

If we had recorded in 1924 a distribution of industrial activities very closely parallel to that of 1907, and the price changes in the interval had been unaffected by this stability of economic structure, the distribution of weights in the Index-Number would, according to these calculations, have been such as to make the division between Food, Drink and Tobacco on the one hand, and the rest of the list on the other, in the ratio of 55 to 95 instead of 53 to 97. Meat would have retained its weighting of 17, but cereals would have lost a point while miscellaneous foods gained three points. Iron and Steel would have been reduced from its weighting of 24 to 20, and the non-

ferrous metals would also have lost, being reduced from 8 to 5 in importance. Coal would have held its relative place, cotton, owing to the very high range of prices ruling at the more recent date, would have been assigned a weight of 22, the other textiles would have gained a point (wool), while the miscellaneous group would have lost two points. Though these figures, as already indicated, are a little speculative, they provide a background to the picture. The revised scheme of weighting, in which both quantities and prices of 1924 have been taken into account, may probably be interpreted as reflecting increased importance of the industrial products, relative to food, in the proportion, not of 98 to 52 as against 97 to 53, but as against 95 to 55.

The outstanding changes in the distribution of weights are, (i) the decreased *relative* importance of meat, taking fresh and refrigerated meat and bacon together, from that represented by a weight of 14 to that represented by a weight of 12, (ii) the decrease from 10 to 7 * in the weight assigned to coal and (iii) the decrease in the importance of the Cotton group, reduced from a weight of 16 to one of 14, while the price movement alone would have resulted in a sharp increase. The reduction reflects the sad condition of the cotton industry and needs no comment. It would not be difficult to suggest causes for the other outstanding decreases, but reference to increases of corresponding or even greater importance must not be postponed.

First in the list of important increases comes the case of paper, raised from a weight of 2 to that of 5. The rise in prices, as indicated by the quotations hitherto used to represent this section, has been greater for paper than for the average of all articles used in compiling the Index-Number and the uses of paper have expanded considerably more than corresponds to the growth of population. Paper has become an instrument of luxury. The lavishness of our modern use of paper—printed or plain—is one of the outstanding characteristics of the present age. The quantities of paper and board available for use in the United Kingdom in 1924 exceeded, in the aggregate, by 50 per cent. the corresponding quantities for 1907 for the United Kingdom as then constituted. Further, in the form in which it appears in the record of output of the paper-using industries proper, there is superimposed on the advance in the value of the material employed a further important advance in average value, the extent of which cannot be measured satisfactorily on account of the lack of suitable units of quantity.

Wool products come next in the order of increase of relative importance in the Index-Number, the assigned weight being 11 as against 9 on the 1907 basis. This increase is not due to quantitative

* If half-units were used, a closer representation would be 10 to 7½.

increase, but to a rise in prices much in excess of the average. With an average increase equal to that in the prices of all articles covered by the Index-Number, the weight assigned to wool would have decreased.

When we come to variations of a single unit in the weighting, relatively small changes, of no great significance, may, in some cases, account for such variations, fractional adjustments being ruled out. Items that just attained sufficient importance for separate treatment at one date may have just fallen below that relative degree of importance at the other. Price changes have contributed to such results in the case of the minor non-ferrous metals.

In reference to the increase in barley, it will be recalled that the weighting of barley takes into consideration its use for brewing and for distilling purposes. The increase in duties is, in fact, a major influence in bringing about the increased weighting assigned, not only in this case, but also in that of sugar and tobacco. The changes in meat have already been mentioned, and, lest the unchanged weight assigned to mutton and lamb be taken to imply more than the facts warrant, attention may be drawn to the fact that a whole unit change has greater relative importance the smaller the quantity subjected to the change. It should not be sought to deduce from the proposed weighting a claim that the consumption of mutton has held more steadily than that of beef or pig-meat. It is germane to the question to note that the price of both mutton and lamb had advanced, in the Census interval, more than that of beef and of veal, and that the latter had advanced more than that of pork and bacon. In the food group there remains the somewhat puzzling case of fruit and vegetables, inasmuch as vegetables have advanced in price by more than the average of all articles, while the available records relating to fruit indicate some lagging behind the general average in this case. The report of the Ministry of Agriculture refers to a slow reduction in the area of orchards and small fruit in the intercensal period 1908-25, but vegetables do not appear to have shared in the reduction. The adjustment proposed appears to be in conflict with general impressions, but it is deduced from the statistical data available, which are not as complete as could be desired, particularly for the earlier date.

On the industrial side of the Index-Number, the increased importance proposed for Iron and Steel appears to be in conflict with the generally depressed state of the industry. It must, however, be remembered that Engineering, in some of its branches, has made steady advances, and particular importance attaches to the development of motor engineering. Having in mind what was indicated earlier, namely, that, apart from expansion in the volume of goods

made, a reduced importance would have been assigned to Iron and Steel, the advance of a single unit in the weighting may perhaps be taken to connote a volume expansion of something like 20 to 25 per cent. in the seventeen-year interval, a proportionate growth not far from that in the total numbers employed in the group as a whole.

The increase from 2 to 3 in the weighting of silk and artificial silk may be presumed to result from the development of the latter industry in particular. In the case of the Chemical industry, the increased importance relative to industry in general will surprise no one, and an increase in the importance of Oils and Fats, a group which comprises Seed Crushing and Soap Making, is also what general knowledge of industrial progress might lead us to expect.

Effects of the new Calculations.

And now it may be asked what effect the modified scheme of weighting produces on the calculated Index-Numbers. The following general summary has been made from the data relating to the year 1924, the published group figures with 1913 as base year being stated in the left-hand column below, for comparison with the results, in the right-hand column, of the modified weighting. A fuller examination of the effects of the change can be made with the help of a table for which I am indebted to the Board of Trade, and which is reproduced in Appendix II. This table shows, on the basis 1924 = 100, the group averages for each of the years 1925 to 1932 on the new scheme of weighting, with the already published figures reproduced for ready comparison.

Price Indices for the Year 1924 on the two plans of Weighting.

	Weighted by	
	1907 Distribution.	1924 Distribution.
Cereals	160.1	160.5
Meat and Fish	153.6	155.5
Other Food and Tobacco	184.4	190.5
Total of Food, etc.	166.3	169.9
Iron and Steel	142.9	142.9
Other Metals and Minerals	143.9	141.2
Cotton	227.8	227.8
Other Textiles	195.8	195.7
Other Articles	157.6	159.8
Total, not Food	165.9	166.2
All Articles	166.2	167.7

It will be noted that, generally speaking, only small changes result from the modified weighting, apart from any effects of the introduction of new price series where the new weighting requires it, or where experience has indicated the desirability of replacing series that have proved to be unreliable, or otherwise not capable of giving results that correspond to expectation, *e.g.* in their regularity or in the promptitude with which they are available. The largest change is in the "Other Food, etc." group, where increased importance is given to Sugar and Tobacco, each of which commodities has had an exceptional rise in price in the period 1913-24. A rise of about 3 per cent. in the group index is shown, which is the main cause of the rise of about 2 per cent. in the "Food" index. The industrial section shows less change, partly because, in two groups, the changed importance of the groups has not been permitted to affect these group indices. The total effect is to lift the aggregate index for 1924 (1913 = 100) by 1 per cent. This may not mean that the changes during the period for which the indices have been calculated, 1920-32, have been no more important than this figure implies. Only in one of the years 1925-32 does a difference in excess of 1 per cent. in the index for all articles (1924 = 100), or for industrial materials alone, result from the changes in weighting. For the Food section there are three cases of substantially greater divergence, and in Group III no year shows a difference of less than 1 per cent. Such figures, however, provide an incidental illustration of the relatively small effect on an index-number that results from changes in the plan of weighting that are not in themselves considerable. So far as it goes, it may give us some confidence that the use for over thirteen years of a system of weighting based on calculations already antiquated at the time that they were taken into use has not been unjustified. The fact that no better basis was available required the use of the facts that were known, even if they did not apply to a very recent period. The figures that have been calculated have not, as it was to be expected they would not, failed to provide a measure, sufficiently close not to be the cause of serious misunderstandings, of the times and extent and detailed character, of the changes in wholesale prices in the United Kingdom.

While this is the case, we should not be justified in ignoring the indications of a more appropriate scheme of weighting, nor in neglecting to take the opportunity that will be afforded by the speeding up of the reports of the 1930 Census of Production, to consider at no distant date how far 1930 experience points to a further modification of the weighting scheme, and perhaps some changes in the formation of the groups in which the results are summarised. Since 1924 important changes in our industrial and commercial position have

occurred and, though it was subsequent to 1930 that some of the most disturbing changes have taken place, disturbing to the structure of our industrial life, that is to say, 1924 is already a date of the comparatively distant past, and its indications may not fit well to the measurement of important factors in the economic life of the present and of the immediate future.

As far back as 1897,* I presented to the Literary and Philosophical Society of Manchester a little study of the extent to which the actual measurements of price changes over a score of years were affected by the contrasts between the price structure of the distant and different periods serving as bases for the two then best known price indices calculated in England, namely, that of the *Economist* newspaper and that prepared by our colleague in this Society, Augustus Sauerbeck. As I took occasion to recall in my paper, read in this place in 1921, serious results on the measurement of changes over relatively short periods, not close to the basis date, may follow from the effective ignoring of the price changes between the basis dates of such index-numbers and subsequent periods the price variations of which it is desired to study in the light of these admired and trusted calculations. The *Economist* newspaper has twice since 1897 revised its method of calculation, recognizing the desirability of maintaining close contact with the period on the events of which the results of these calculations are expected to throw useful light. I should anticipate that a plan to bring another price index-number than their own into as effective touch with current conditions as possible would win the approval of such experienced workers as those concerned with the *Economist* price indices. No provision of this kind is made in the late Mr. Sauerbeck's recorded plan of calculation of the Index-Number the annual survey of which still finds an honoured place in the pages of our *Journal*. There is, in fact, a school of workers in statistics who never cease to call for an index-number which will record on a plan the structural details of which are preserved immune from change the movements of prices over a period the duration of which shall have no assigned limits. One difficulty in dealing with the problem is familiar to all who have used such index-numbers in a way that involves acquaintance with their detailed structure. Commodities that were market leaders at one time are found, at a later period, to be mere dummies, the price movements of which have no significance. New series of price quotations must, of necessity, be found to replace such moribund data. Does not the admission of this necessity, which no one is concerned to dispute, carry with it the obligation to anticipate the coming need for the excision of dead methods as well as dead material? And can it fail to affect unfavourably the useful-

* Manchester Memoirs, Vol. xli (1897), No. 12.

ness of an index-number if replacement of dying material is deferred until that material has plainly become useless?

If that is so, it appears to me to affect the significance of calculations, such as have been brought before this Society within quite recent periods, in which the relation of other phenomena to price movements is measured by comparisons with a price index calculated by a formula preserved from change over more than a century. It is simply impossible, however excellent the general design of such an index-number may be, that an unchanged formula should give results equally significant of actual conditions in each of the decades of an entire century. We know how remarkably well, for example, the Sauerbeck Index has behaved, and, broadly speaking, are justified in regarding it as a reliable guide to price changes. I do not wish to speak ill of so excellent a piece of work. But when a quite obvious source of uncertainty in registration of changes is lost sight of, and an important significance is attached to the closeness of fit of variations in some other phenomenon and the fluctuations of such an index-number, it is necessary to point out a serious weakness of the argument adduced. How great a precision in the measurement of price variations is needed for any specific purpose must be considered before we are prepared to contemplate acceptance of deductions from price data whose great attraction is the length of the period during which they have been calculated without varying the formula of combination of the elements of the Index-Number. In 1897 I showed that while the Sauerbeck indices, with their base period 1867-77, gave, for the price change between 1876 and 1886, a fall in the ratio of 137 to 100, a recalculation in which the value of each item in the index is taken as 100 in 1886, shows the same movement as a fall in the ratio of 141 to 100. Is the difference in the measurement of movement over a decade, thus revealed, sufficient to disturb the significance of the correlation of other measured phenomena with price variation? If not, then within these limits the possible deduction of different results by the use of the same formula will not perhaps matter. The corresponding calculations with the *Economist* data showed that, using the figures as published and calculated with 1845-50 as base period, a price fall is indicated in the ratio of 134 to 100 during the period 1876 to 1886, while the same series of prices, if 1886 be taken as base year, showed the price fall to be approximately in the ratio of 142 to 100. Having such possibilities in mind, and in spite of the close parallelism shown by both methods of calculation to have affected the movements of the next following decade, 1886 to 1896, for each of these two index-numbers, can we accept as convincing an algebraic, or diagrammatic, presentation of close agreement between the variations of such phenomena as gold

supply, and wholesale prices, thus calculated, over half a century? It is surely of serious importance that the price variations are subject to not inconsiderable changes in their measure by merely shifting the date from which the variations are measured. I am disposed to the view that questions often put to statisticians, regarding comparisons between present average prices and those of a hundred years ago, or even further back, do not become answerable rationally by the mere fact that a method of working out a price average has been applied with unchanged uniformity throughout the period in question. With reference to changes in time, as to changes in position on the globe, useful and significant comparison requires a degree of general similarity between the conditions to be compared which is often lacking. The absence of such comparability of conditions may render any comparison of painfully prepared arithmetical results quite lacking in significance.

If an index-number of prices or production, or like economic phenomena is to give a close measure of the variations which it is desired that it should represent, it is likely to need relatively frequent adjustment. To link up into a continuous series a number of such short-period indices involves a degree of arbitrariness which may be more or less important according to the circumstances of the individual case. If, for instance, in connection with problems of relative price variation in different countries, and their relation to rates of exchange between the currencies concerned, price indices are to be employed, it might be risking more than is justifiable were indices used whose first claim to respect was the antiquity of their scheme of compilation and the length of time during which custom had developed a trust in their reliability. In an age in which the control of banking policy by reference to price movements is freely discussed, the kind of measure of such price movements on which reliance would be placed may well be the subject of careful criticism.

International Price Comparisons.

These considerations bring me to the last of the matters to which I wish to direct your attention to-day. The confusion of currency relations which, from the autumn of 1931, has spread over more and more of the civilized world, has brought into the foreground the question of the comparative importance to a nation of stability in its internal prices and stability in the relation of its currency unit to those of other countries. It appears to be assumed that fixed relations of the currency units will ensure parallel movements in prices in the countries concerned. This is clearly stated in the *Times* report of an address broadcast from London to the United States last night by Professor Gustav Cassel, and it is a view that was

reflected in the discussion on my paper of 1921. The material for examining what has actually taken place in the past in this connection is far from satisfactory. Not unnaturally, the price indices compiled by official organizations, or by important institutions of a more or less private character, differ in structure, so that it is by no means certain that similarity in movement of the indices will result from a fundamentally similar series of variations in the actual prices prevailing in the different countries.

In recent years the examination of this question has suggested itself in various quarters. Students of the reports of the German Institut für Konjunkturforschung will have found, from time to time, references to work undertaken by that body in this field.* A committee of statisticians from a number of countries, under the auspices of the League of Nations and the guidance of our colleague Mr. Loveday, after considerable discussion and some examination of the earlier results of this work in Berlin, adopted a resolution that approved, for the purpose of inter-country comparisons of price movements, a procedure which, in essence, was that of the German organization. Independently of this, I encountered last year another effort on the same, or at least on similar, lines in a thesis submitted by a candidate for a degree in a University where I happened to be functioning as external examiner.

The method of comparison is to take, for each of two countries to be compared, the same formula of combination of the separate series of measures of individual price variation. Thus, in comparing German prices with English prices, the scheme of weighting adopted in this country, or that adopted in Germany, may be used, but comparisons will be limited to the results reached in the two countries by one and the same procedure in combining and summarizing the price movements. Preferably the calculations should be made by both of the methods used in the two countries. By such means it will be possible to determine how much of the differences indicated by the comparison of the indices of the two countries is to be attributed to differences in the price movements themselves, and how much to differences in the formula of combination used in Germany and that used in England. Some of the results presented are very striking and any student interested in the matter, who may not have had his attention called to this work, would do well to examine the material presented in the course of last year and the present year.†

From the middle of 1927 to the autumn of 1931 the new mode of comparison brings the indices of wholesale price-movement in

* See also Dr. Wagemann's *Struktur und Rythmus der Weltwirtschaft*, p. 111 and following pages.

† *Vierteljahrshefte zur Konjunkturforschung*, 6 Jahrgang, Heft 4, and 7 Jahrgang, Heft 1 and Heft 3.

Germany and in England into very close correspondence. The data used are the Board of Trade Index-Number and a parallel German calculation in which German price data replace the British price data. After September, 1931, the question of the representation of the British index on a gold basis introduces confusion. In the latest comparisons the calculations have been extended to other countries, and the results for French, Czechoslovakian and United States comparisons are shown. The variations in the German indices according as the British, French, Czechoslovak or United States formula of combination is employed will interest the curious. The closeness of agreement in the indices of movement made thus comparable varies considerably from country to country. For Germany and Czechoslovakia the agreement is comparable to that in the case of Germany and Great Britain. In the comparison with France it is indicated that a definitely larger increase on 1913 prices has occurred in Germany than in France; while U.S. prices were, before the breakdown of 1929, quite markedly higher, in comparison with 1913, than those of Germany, but have since gradually approximated, and from the middle of 1931 differed comparatively little in the degree of advance from the pre-war position.

These calculations appear to me to be of great importance. They extend to a wider field the comparisons between prices in eleven different countries made by Dr. Bowley in a memorandum issued by the London and Cambridge Economic Service.* Those comparisons were limited to 35 commodity prices, and to secure so many items as this on a comparable basis for eleven countries is no small task. The broader basis of the German calculations may be significant in a different degree with regard to the inter-relations of money and prices in the countries compared.

I have for a considerable time had a desire to join in the work of comparison, but pressure of other matters has been too great. I have, however, prepared for your consideration to-day a comparison of the Board of Trade Index with an index of United States prices in which the British system of combination is applied to United States prices. The rich abundance of material published in the Washington bulletins has presented the possibility of selecting, for most of the 150 prices series used in the Board of Trade compilation, corresponding series for the United States. In a moderate number of cases the parallelism of commodities leaves something to be desired, but the particular industrial groups concerned can be represented by what

* Cf. Special Memorandum No. 24, "Comparative Price Index-numbers for Eleven Principal Countries." Yearly averages for 1922, 1923 and 1924 were given and figures for each month from January, 1925, to January, 1927. Later figures have been given in the Bulletin of the Economic Service for March, June, September and December of each year.

appear to be suitable price series. Where, in some cases, a smaller number of varieties of the same commodity are quoted in the American publication than are needed for comparative purposes, a double use of one of the American series, or the addition, to a group, of a series representing the group average, instead of a price series for an additional commodity, has been resorted to. I have avoided the general use of price series for manufactured goods, so frequent in the American data, so as to maintain for the two countries a representation of goods at a similar stage in production. Further minute details of the working procedure will not be necessary, and, in effect, would require an exhaustive list of the items selected from the American reports as corresponding to the British price series.

The results which I am able to present cover the years 1927–31. The United States basis of reference is the year 1926, and, while I have presented the British figures on the basis $1926 = 100$, I have not carried the calculations back into the time when the United States procedure in calculating the Index-Number differed from that established in 1927. A wider range of choice of material for comparison is thus secured. The diagrams show the course of the movements in the two countries during a period which may well serve to test the usefulness of the procedure illustrated, in view of the very wide variations in prices which occurred during its latter portion. Monthly data are shewn in Appendix IV.

It will be seen that the Bureau of Labor index-number shows prices in the United States as falling in the spring of 1928 but recovering markedly later, and finally breaking only in the autumn of 1929, while in this country a fall occurred in the spring of 1928, from which the recovery was slight, and the breakaway of the autumn of 1929 was from a range of prices lower, compared with those of 1926, than that in the United States. The calculations with the Board of Trade formula of combination show an interesting gradual approach of the index-numbers for the two countries during 1930, the index-number for the United States falling below that for the United Kingdom early in 1931. The large degree in which prices representing manufactured goods are used in the United States official compilation may probably be the main reason of the divergence between the published figures of the Bureau of Labor and the index deduced by the use of a selected group of items included in that index.

I hesitate to interpret the relative movements of the two indices resulting from the same principle of representation of the material. A great strain on the price relations of the two countries during the whole period from the spring of 1927 at least well into the year 1930 seems to be indicated. If the gold parity truly represented price

relations between the two countries in 1926, the equivalent of the pound in terms of dollars that would appear to correspond with the price situation of 1928 and 1929 would be something in excess of 5 dollars. In the third quarter of 1931, an average rate of little over \$4.70 to the £ would represent the purchasing power parity. The year 1926 was, it must not be forgotten, a year of considerable economic disturbance in the United Kingdom, and the relation of prices here to those elsewhere was probably abnormal, in some degree at least. The two diagrams showing the divergences between U.K. and U.S.A. indices can, however, be adapted quite readily to a base year other than 1926, so far as the Board of Trade index and the parallel index calculated for the U.S.A. are concerned, owing to the fact that both are geometric averages. For the year 1928, the U.K. index ($1926 = 100$) is 94.7, and that for the U.S.A. is 98.4. Consequently, if 1928 were taken as base year, the zero line of the first of these two diagrams would be raised to the +3.9 level, the diagram remaining unaltered in shape. For the second of the "divergence" diagrams, the comparison of food prices on the basis $1928 = 100$ requires the zero line to be raised to the +2 level and that of materials requires the zero line to be raised to the +4.4 level. During the period from early in 1928 almost to the middle of 1930, the exchange on the then fixed gold basis did not correspond closely to the relation of price movements in the two countries. At that time the invisible items in the balance of current obligations of this country had not suffered the catastrophic reduction of 1931, and the international movements of short-term capital may account for the maintenance of relative price levels not corresponding to the fixed exchange rate resulting from the adherence to the gold standard.

This last statement is possibly not fully justified, since we cannot be certain that the divergences shown in the diagram are not, at least in part, the result of including, in the price averages compared, goods which, in one or other of the countries, or in both, are not within the circle of goods with which international trade is concerned, and where the possibility of actual movement of the commodities serves to prevent price divergences exceeding a more or less determinable magnitude. In other words, our price index-number is, possibly, not a form of index-number adapted to measure fluctuations in that aggregate of commodity prices by which exchange conditions are affected. Whether this consideration has any considerable importance it is difficult to determine *à priori*. As, however, we are a body of persons who, by the fact of our association in the Royal Statistical Society, are interested in statistical enquiries, it will be quite permissible for me to suggest that the further cultivation of the field of

enquiry to which I have tried to-day to make a small contribution might result in enabling us to see the problem of the relation of price movements in different countries in a new light. Possibly it might furnish useful warnings against some types of international currency agreements, regarded as means towards facilitating the establishment of smoothly working trade arrangements.

APPENDIX I.

Comparison of "weighting" according to the data of 1907 and 1924

		1907.	1924.
A. Food, Drink and Tobacco :			
(i) Cereals.	Wheat	7	7
	Barley	5	6
	Oats	2	2
	Maize	1	1
	Rice, etc.	2	1
(ii) Meat and Fish.	Beef and Veal	6	5
	Mutton and Lamb	3	3
	Pig-meat	5	4
	Poultry, Eggs, etc.	2	2
	Fish	1	1
(iii) Other Articles.	Dairy Products	7	7
	Fruit and Vegetables	5	4
	Sugar	2	3
	Tea, Coffee and Cocoa	3	3
	Tobacco	2	3
Total, Food, Drink and Tobacco		53	52
B. Industrial Materials :			
(iv) Iron and Steel		24	25
(v. a) Non-Ferrous Metals.	Copper	4	4
	Lead	1	1
	Zinc	1	1
	Nickel	1	1
	Tin	1	1
	Aluminium, etc.	—	—
(v. b) Minerals.	Coal	10	7
	Petroleum	2	2
(vi) Cotton		16	14
(vii) Other Textiles.	Wool	9	11
	Silk, Natural and Artificial	2	3
	Linen	2	2
	Jute	1	1
	Hemp	1	1
(viii) Other Articles.	Chemicals, Oils and Fats... ..	7	9
	Paper	2	5
	Leather	4	4
	Rubber	1	1
	Timber	4	4
	China and Glass	1	1
	Bricks	1	1
	Stone	2	1
Total, Materials, etc.		97	98
Total, All Articles		150	150

APPENDIX II.

Comparison of Annual Index Numbers (1924 = 100) weighted in accordance with 1907 distribution and with 1924 distribution, respectively.

Weighted by 1907 distribution. (The index numbers as published.)

	Weight.	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.
I. Cereals ...	17	102.1	93.8	95.1	93.1	86.1	68.1	56.1	60.4
II. Meat and fish ...	17	105.3	100.1	89.5	91.7	95.2	91.3	75.5	68.8
III. Other food ...	19	93.9	86.6	89.7	90.4	82.4	71.8	71.0	70.7
Total food ...	53	100.1	93.1	91.4	91.6	87.4	76.1	67.0	66.5
IV. Iron and steel ...	24	88.2	86.4	83.9	78.6	79.9	78.9	73.4	72.6
V. Coal ...	10	84.7	107.1	77.5	68.4	72.2	70.4	71.4	71.5
VI. Other metals and minerals ...	10	101.1	99.8	93.1	89.0	96.5	79.0	65.0	66.9
VII. Cotton ...	16	92.1	69.5	67.9	72.1	67.8	53.2	42.5	42.1
VIII. Wool ...	9	89.9	77.4	77.5	81.9	75.6	55.9	45.6	41.2
IX. Other textiles ...	6	103.8	89.1	83.6	83.2	79.5	61.4	48.6	47.8
X. Miscellaneous ...	22	99.8	92.0	90.4	90.3	86.0	78.5	67.0	61.0
Total, not food ...	97	93.4	87.0	82.0	80.7	79.4	69.6	60.3	58.4
All articles ...	150	95.7	89.1	85.2	84.4	82.1	71.9	62.7	61.1

Weighted by 1924 distribution.

	Weight.	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.
I. Cereals ...	17	102.5	93.5	96.0	93.8	86.4	67.2	56.0	60.7
II. Meat and fish ...	15	104.8	99.0	88.8	91.1	94.4	90.3	75.1	68.2
III. Other food ...	20	92.4	85.6	88.8	88.9	81.0	70.9	69.7	69.5
Total food ...	52	99.2	91.9	91.1	91.1	86.4	74.7	66.3	66.1
IV. Iron and steel ...	25	88.2	86.4	83.9	78.6	79.9	78.9	73.4	72.6
V. Coal ...	7	84.7	107.1	77.5	68.4	72.2	70.4	71.4	71.5
VI. Other metals and minerals ...	8	98.8	98.9	93.9	90.6	99.6	81.8	67.0	67.3
VII. Cotton ...	14	92.1	69.5	67.9	72.1	67.8	53.2	42.5	42.1
VIII. Wool ...	11	89.9	77.4	77.5	84.9	75.6	55.9	45.6	41.2
IX. Other textiles ...	7	102.7	90.2	84.0	83.0	79.5	61.2	48.9	47.6
X. Miscellaneous ...	26	99.2	91.5	88.2	87.7	85.0	77.9	65.2	58.8
Total, not food ...	98	93.3	86.5	82.1	81.1	79.7	69.9	60.0	57.4
All articles ...	150	95.3	88.3	85.1	84.4	82.0	71.5	62.1	60.3

APPENDIX III.

Changes in Sources of Price Quotations for Use in Compiling the Board of Trade Index-Number.

Original Quotation.	Quotation Used at Present Time.
Flour—London, G.R.; average of Whites and Town Households. Norwich, household.	London, straight run, ex mill. Norwich, straight run.
Oats—Canadian Western.	Plate, f.a.q. London.
Barley—American feeding.	British feeding.
Beef—Argentine frozen, average forecs and hinds, 1st Leeds and Birmingham.	Australian frozen, average hinds and crops, 1st Leeds and Birmingham.
Bacon—Irish smoked, 1st Liverpool.	Irish green, 1st London.
Butter—British dairy, 1st London.	Blended, 1st London.
Sugar—British West India crystals.	Fine granulated, Greenock.
Coffee—Costa Rica, good to finest.	Average of Costa Rica, good to finest and Kenya, good to fine bold.
Cocoa—Guayaquil, raw.	West African, London.
Pig Iron—Derby, Leicester and Nottingham No. 3 Foundry.	Derby No. 3 Foundry.
Steel—Tinplate and sheet bars.	Tin bars and sheet bars.
Heavy melting scrap (without analysis).	Heavy melting scrap average South Wales and Cleveland.
Scotland: Angles and bulb angles, tees and zeds, flat bars, rounds and squares, channels.	Scotland: angles.
Coal—Fifeshire: screened navigation.	Fifeshire: average 1st and 3rd class steam.
Yorkshire: Barnsley Best silk-stone.	Leeds Best house.
Midlands: Derby Best brights.	Notts Best brights.
Derby Best small nuts.	Notts Best small nuts.
Petroleum—American standard white in barrels at London.	Royal Daylight, per gallon, for England and Wales, excluding London.
Motor Spirit No. 1, per gallon.	Pratt's High Test, per gallon in cans and steels, for England and Wales, excluding London.
Wool—Southdown tegs or ewes 56's and 58's washed, Bradford.	Southdown tegs or ewes 56's and 58's greasy, Bradford.
Linen—Cambric warps, 45's.	Cambric warps, 60's.
Silk—China Blue Elephant.	Raw, Japanese and Italian.
Milanese.	Crêpe de chine and Japanese habutac.
Hemp—Manila, J. Grade.	Manila fair.
Ammonium Sulphate—London, net.	Ammonium Sulphate, Neutral 20·6% N. (delivered).
Leather—Ox and heifer hides, 1st— 70/79 lbs. } 60/69 lbs. } average. 50/59 lbs. } 49 lbs. and under } average.	Ox and heifer hides, 1st— 70/79 lbs. } average of clear 60/69 lbs. } and warbled 1sts } aver. 50/59 lbs. } 49 lbs. and } ditto } aver. under }
Cow hides— Heavy 1st } Light 1st } average.	Cow hides— Heavy 1st } Light 1st } ditto } aver.
Calfskins 17/25 lbs.	Calfskins 17/24 lbs. clear, 1sts.
Timber—Dry wainscot oak, per foot super., as inch, lower price.	American figured oak, per foot cube.
Dry mahogany, per foot super., as inch, lower price.	Dry log cut Honduras Mahogany, per foot cube.
Bricks—3-inch clay bricks.	Average of Stocks and Flettons.

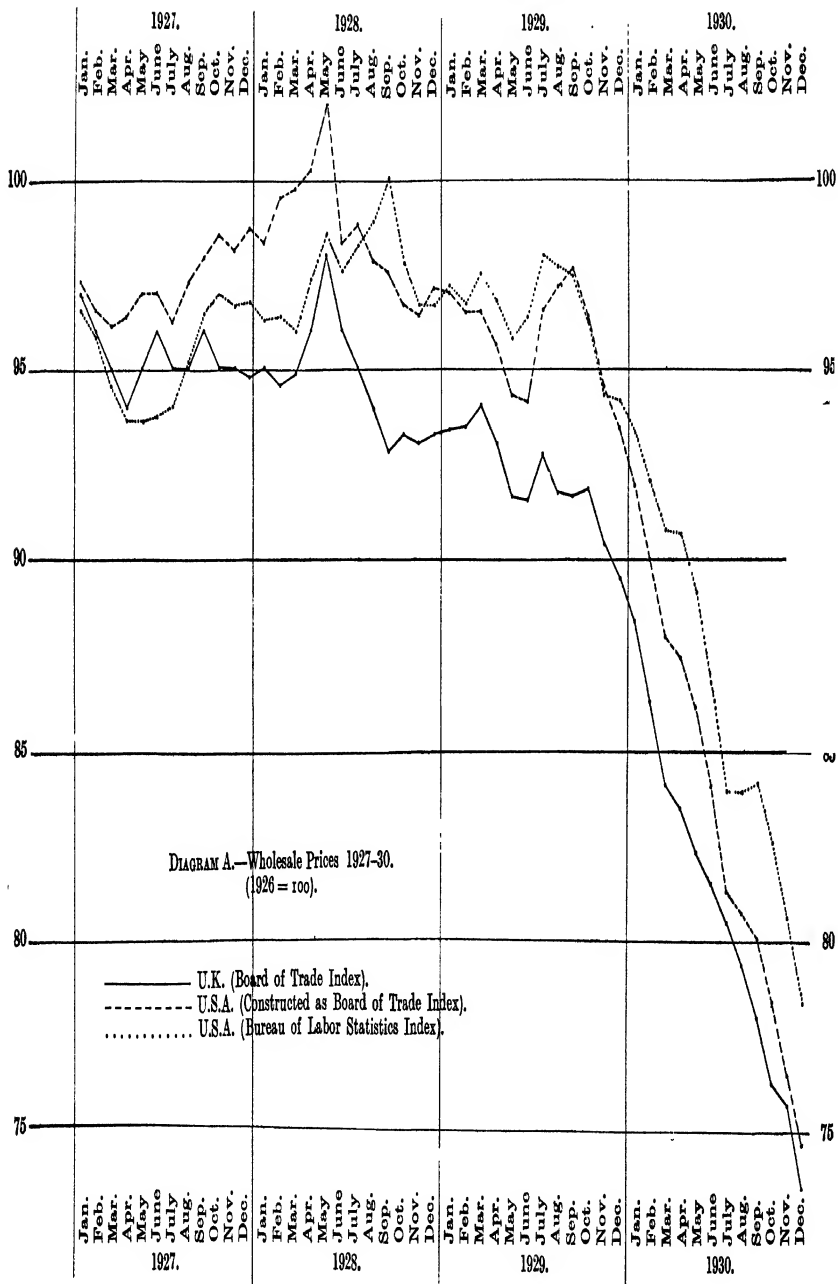
APPENDIX IV.

Index-Numbers of Wholesale Prices (1926 = 100).

			Complete Indexes.			Foodstuffs.		Materials.	
			Board of Trade.	Parallel U.S.A. Index.	Official U.S.A. Index.	Board of Trade.	Parallel U.S.A. Index.	Board of Trade.	Parallel U.S.A. Index.
1927	Jan. ...	...	97.1	97.3	96.6	99.2	99.9	96.0	96.0
	Feb. ...	...	96.3	96.6	95.9	98.4	98.9	95.2	95.4
	Mar. ...	...	95.1	96.2	94.5	95.0	98.3	95.2	95.1
	Apr. ...	...	94.5	96.4	93.7	95.7	99.2	93.9	94.9
	May ...	...	95.5	97.1	93.7	98.7	101.4	93.7	94.8
	June ...	...	96.0	97.1	93.8	100.9	100.7	93.3	95.2
	July ...	...	95.5	96.3	94.1	99.3	97.3	93.6	95.7
	Aug. ...	...	95.4	97.3	95.2	97.7	97.8	94.1	97.0
	Sept. ...	...	96.3	98.0	96.5	99.0	97.6	94.8	98.1
	Oct. ...	...	95.7	98.5	97.0	98.5	99.5	94.3	97.6
	Nov. ...	...	95.3	98.2	96.7	98.2	100.5	93.8	96.9
	Dec. ...	...	94.8	98.7	96.8	97.5	102.0	93.2	96.9
1928	Jan. ...	...	95.4	98.3	96.3	98.9	100.2	93.5	97.2
	Feb. ...	...	94.6	99.5	96.4	97.9	103.7	93.0	97.3
	Mar. ...	...	94.9	99.8	96.0	98.2	104.7	93.2	97.1
	Apr. ...	...	96.6	100.3	97.4	102.5	106.2	93.5	96.9
	May ...	...	98.1	102.1	98.6	102.9	106.8	93.8	97.5
	June ...	...	96.2	98.1	97.6	101.7	100.1	93.5	96.9
	July ...	...	95.3	98.6	98.3	98.7	100.4	93.5	97.6
	Aug. ...	...	94.0	97.9	98.9	97.4	98.5	92.3	97.5
	Sept. ...	...	92.9	97.6	100.1	95.3	97.9	91.7	97.4
	Oct. ...	...	93.3	96.7	97.8	95.8	95.9	91.8	95.6
	Nov. ...	...	93.1	96.4	96.7	95.9	94.5	91.6	95.0
	Dec. ...	...	93.3	97.1	96.7	95.7	96.3	92.0	95.8
1929	Jan. ...	...	93.4	97.0	97.2	95.3	95.9	92.3	97.6
	Feb. ...	...	93.5	96.5	96.7	96.0	95.4	92.0	97.1
	Mar. ...	...	94.7	96.5	97.5	97.2	94.1	93.3	98.0
	Apr. ...	...	93.6	95.6	96.8	95.1	92.8	92.8	97.2
	May ...	...	91.7	94.3	95.8	92.7	91.7	91.2	95.8
	June ...	...	91.6	94.2	96.4	92.5	91.5	90.9	95.7
	July ...	...	92.8	96.5	98.0	96.0	93.6	91.0	95.5
	Aug. ...	...	91.8	97.2	97.7	93.2	99.5	90.9	95.9
	Sept. ...	...	91.7	97.7	97.5	92.2	100.2	91.4	96.3
	Oct. ...	...	91.9	96.4	96.3	93.7	97.7	90.9	95.7
	Nov. ...	...	90.4	94.5	94.4	92.0	95.9	89.7	93.8
	Dec. ...	...	89.5	93.5	94.2	90.9	95.2	88.6	92.6
1930	Jan. ...	...	88.4	92.0	93.4	89.6	92.8	87.7	91.5
	Feb. ...	...	86.3	89.9	92.1	87.0	90.1	85.9	90.8
	Mar. ...	...	84.1	88.0	90.8	83.7	87.3	84.4	88.2
	Apr. ...	...	83.5	87.7	90.7	83.4	88.2	83.4	87.4
	May ...	...	82.3	86.1	89.1	82.2	86.4	82.2	86.0
	June ...	...	81.5	84.1	86.8	82.3	83.8	80.0	84.2
	July ...	...	80.5	81.3	84.0	82.1	79.9	79.5	82.0
	Aug. ...	...	79.4	80.7	84.0	81.5	81.1	78.4	80.5
	Sept. ...	...	78.0	80.0	84.2	79.9	81.4	77.0	79.4
	Oct. ...	...	76.3	78.4	82.6	78.3	79.5	75.2	77.8
	Nov. ...	...	75.7	76.5	80.4	77.9	76.3	74.4	76.7
	Dec. ...	...	73.5	74.7	78.4	75.0	73.0	72.8	75.6

APPENDIX IV.—*continued.*

		Complete Indexes.			Foodstuffs.		Materials.	
		Board of Trade.	Parallel U.S.A. Index.	Official U.S.A. Index.	Board of Trade.	Parallel U.S.A. Index.	Board of Trade.	Parallel U.S.A. Index.
1931	Jan.	72·3	72·8	77·0	73·1	70·7	71·8	73·9
	Feb.	71·7	70·7	75·5	72·2	66·8	71·4	73·0
	Mar.	71·5	70·5	74·5	71·6	66·1	71·5	72·9
	Apr.	71·4	69·5	73·3	72·4	65·2	70·7	71·9
	May	70·5	68·1	71·3	72·9	63·7	69·1	70·6
	June	69·6	66·6	70·0	72·8	61·2	67·9	69·8
	July	68·9	67·1	70·0	70·4	61·6	68·1	70·3
	Aug.	67·1	65·9	70·2	69·4	60·9	65·9	68·8
	Sept.	66·9	64·9	69·1	69·5	60·8	65·6	67·3
	Oct.	70·5	63·4	68·4	72·8	59·7	69·3	65·5
	Nov.	72·0	63·4	68·3	74·3	60·3	70·7	65·2
	Dec.	71·6	61·9	68·0	73·0	58·2	70·8	63·9



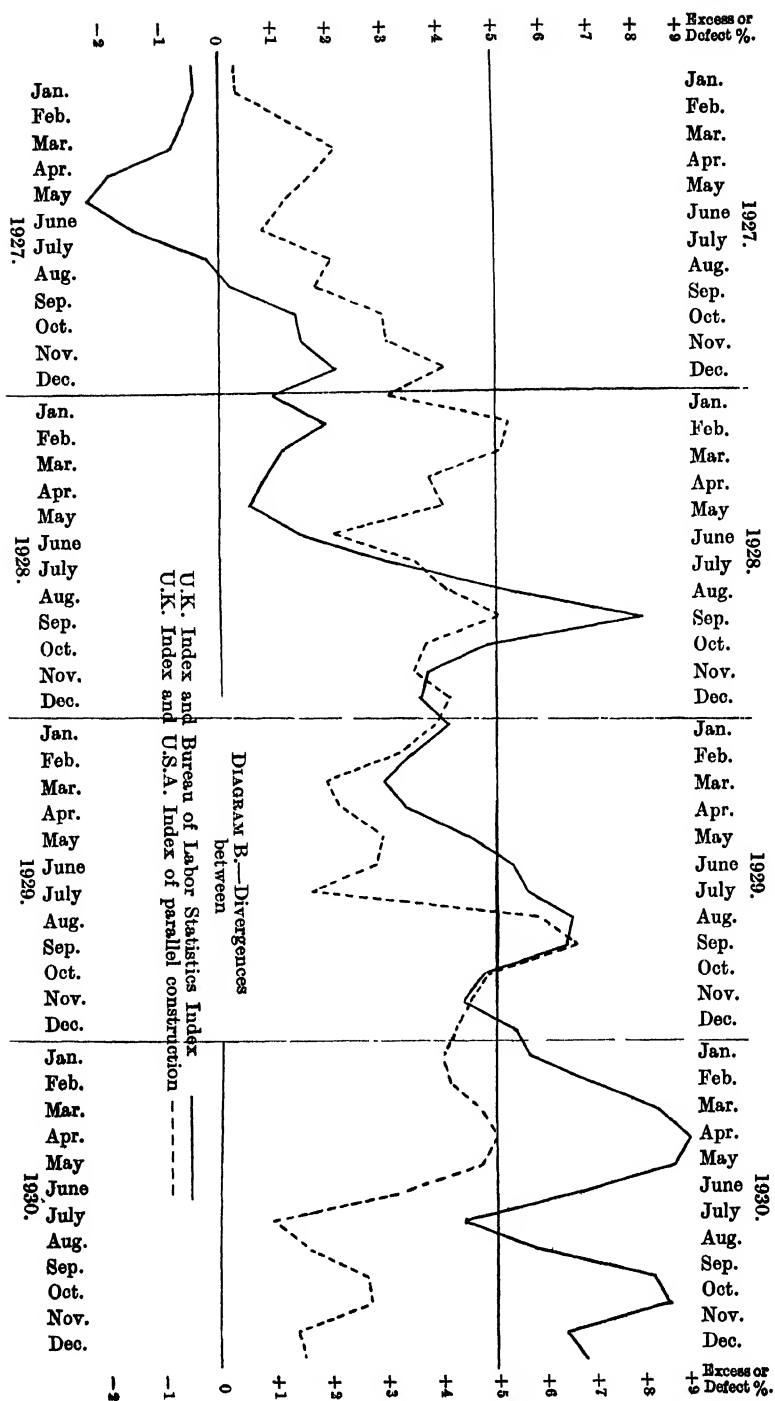
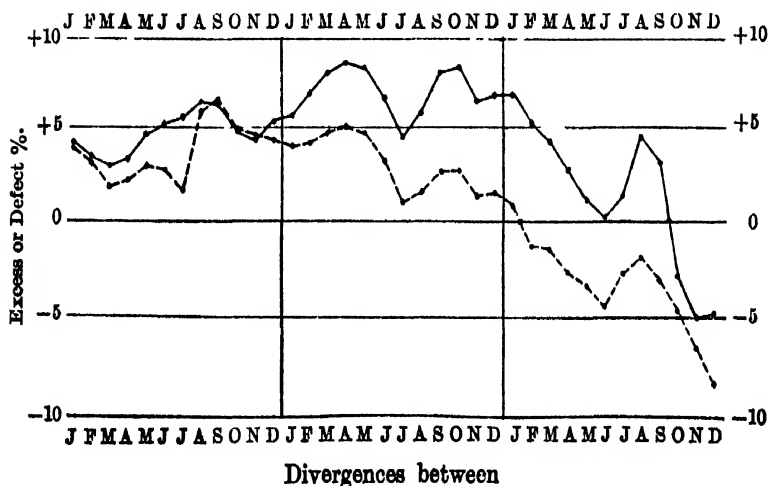
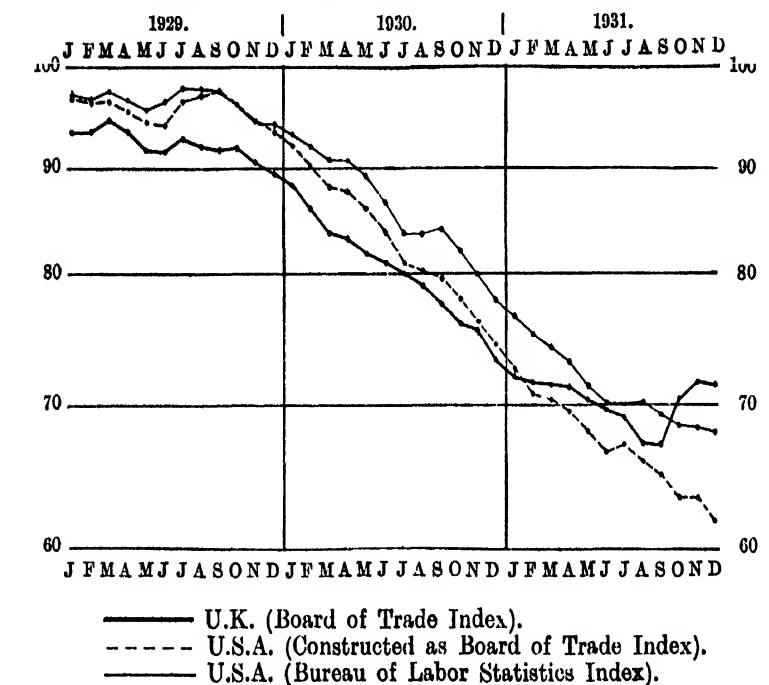
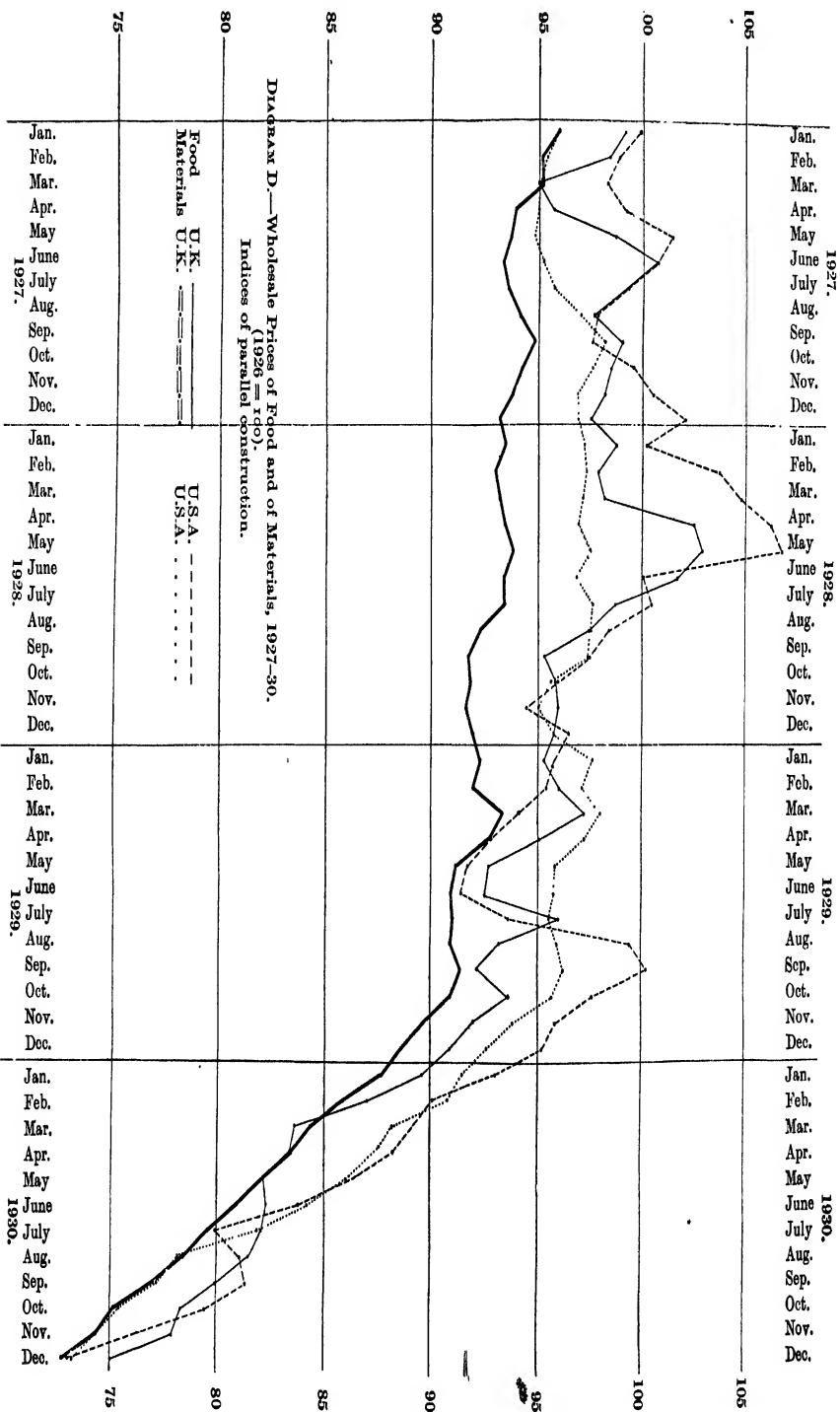


DIAGRAM C.—Wholesale Prices 1929–31 (1926 = 100).





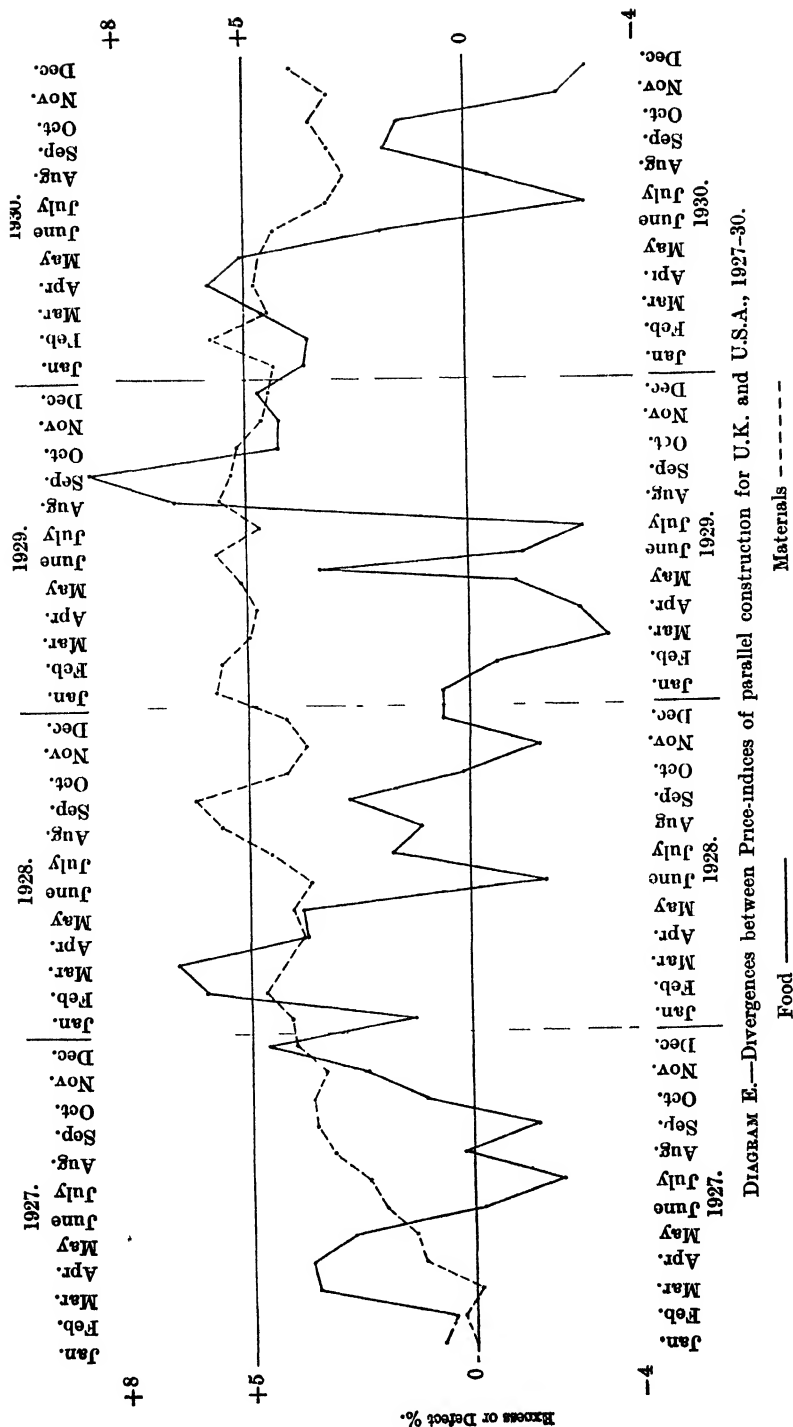


DIAGRAM E.—Divergences between Price-indices of parallel construction for U.K. and U.S.A., 1927-30.

Food ——— Materials - - - - -

DISCUSSION ON MR. FLUX'S PAPER

MR. UDNY YULE: I am afraid the opening sentence of Mr. Flux's paper gave me rather a shock, for it seems by no means twelve years since I had the pleasure of proposing a Vote of Thanks for his paper on "The Measurement of Price Changes" in which he described the methods to be adopted for the present Board of Trade Index-Number of wholesale prices,—an index-number which has now, I think we may say, fully gained acceptance as the best founded and most trustworthy index of wholesale prices that we have. I am very glad to undertake the corresponding duty on this occasion. It is a pleasure to see our former President here again, and I am sure I speak for all of us, when I say that I hope this will be only the first of a series of visits he will pay us from the country of his retirement.

The fresh calculations that Mr. Flux gives us in the first half of the present paper, as to the effect of the changes of weighting, by utilising the results of the Census of Production of 1924, are of considerable interest although the ultimate changes in result are small—in fact, that is one of the interesting results, though it was to be expected. The weighting of the groups as shown in the table on p. 620 is but little altered, notwithstanding considerable changes in the weights of individual items, notably in the case of paper. The change in the weight of paper from 2-5, seems astonishing. As Mr. Flux remarks, the calculations simply provide "an incidental illustration of the relatively small effect on an index-number that results from changes in the plan of weighting that are not themselves considerable."

While I find myself in general agreement with Mr. Flux in his argument on p. 613 to the effect that index-numbers must be revised, and that it is impossible for a number on an unchanging basis to "give results equally significant of actual conditions in each of the decades of an entire century." I should like to refer to one point in that argument. It is not a point of high importance, but I refer to the argument based on the changes made when you alter the year of reference, the year for which you call the index-numbers or "price-relatives" 100. To me this particular argument seems illegitimate. Let me explain my point of view. Suppose a consumption schedule to be drawn up for the country for a certain base-year, showing the quantities consumed of every article to be included in the index-number. The cost of that schedule at the prices of each year, would give us data from which to state a series of index-numbers. Any year could be taken as a "reference year," and the index-numbers for other years obtained by dividing the schedule-cost for that year into the schedule-cost for other years. But we could obtain precisely the same results if we worked out the price-relatives for the individual commodities on the given reference-year, and formed a weighted average of them, using as weights the total values *in the reference year* of the respective commodities consumed. It seems to me that this is really the idea at the back of all weighted arithmetic mean index-numbers: and there is no such

thing as unweighted arithmetic mean index-numbers. All numbers are weighted either by direct weights or by the number of price relatives included. The result is that if you change your reference year, you must change the weights. Both Sauerbeck's and the old *Economist* numbers were, however roughly, weighted by numbers of quotations supposed to be appropriate to their base periods, and you should not alter the reference year without a corresponding change in the weighting. If you make that change you get exactly corresponding results, whatever year you call the reference year.

At the same time, the figures that Mr. Flux has given raise an interesting question in my mind. What kind of figures has he in mind as roughly the limits of trustworthiness of an index-number? It seems to me that in this case the ordinary formulæ of sampling are inapplicable. I have worked at index-numbers of prices much less than Mr. Flux, but I should have thought that even in pre-war days, when the individual price relatives had much lower dispersion, the arithmetic mean of any of the commoner series would only have been trustworthy within two or three points. I should like to know Mr. Flux's views on this point.

In reading his paper Mr. Flux slightly modified the wording on which I was going to comment at the end of that same paragraph, where he seemed to have made his wording a little pessimistic. For I was going to have asked him what would be his answer, for example, to a request for a comparison between prices in the time of William the Conqueror and now? What could be given but "painfully prepared arithmetic results"? One surely would not regard them as quite lacking in significance?

On the last section of the paper I do not think I can say anything useful, but the figures and charts are extremely interesting, and I hope they will be discussed by others. It gives me much pleasure to move a hearty Vote of Thanks to Mr. Flux for his paper.

MR. LEAK: It is with the greatest of pleasure that I second this Vote of Thanks to Mr. Flux for his most interesting paper. It is the last—or perhaps I should say, the latest—of a long series of most valuable papers from his pen. His papers have all been full of original work, and I am sure his contribution to the study of the relative movement of prices of similar commodities in different countries will be of the very greatest value.

I should like first of all to refer to the Board of Trade index-number. Mr. Flux mentioned that this was compiled on the geometric average. He was the first to compile a national index number on that basis, and his example in that direction has been followed by both Italy and Belgium. He has always led the way in many classes of statistics, and in this instance he has led the way very adequately because I am quite certain that the geometric average is the best method for price index-numbers.

During his last few years at the Board of Trade Mr. Flux was much concerned with the necessity for re-weighting this index, but he was unable to find time to do this after all the Census of Production material had been worked up. Some time before his

departure he promised to produce a re-weighting either before or after his retirement, and I should like to express my most grateful thanks to him for redeeming that promise now. I am very glad to be able in this way to take advantage of his great inside knowledge of the Census of Production figures, which are not perhaps so easy of interpretation as some people seem to imagine. I am particularly glad to do this because continuity of method is essential, and unfortunately for some reason no record exists in the Board of Trade as to the method of weighting the original index number. It is a lamentable admission for a Government Department to make, but the Office of Works are really to blame, because they lost the papers during a move.

On the scheme of weighting which is set out in the Appendix I. of the paper, I only want to offer one comment at the moment, viz. that although coal is reduced in importance in the weighting, it seems to me that it is of such great national importance as to merit an index-number by itself, and I should prefer to retain it as a separate item, rather than to include it with petroleum in a group of minerals. If it were really "minerals," surely stone as well ought to be added.

The changes between 1907 and 1924 have resulted in some quite appreciable alterations in the weights, but as Mr. Flux has pointed out, the changes between 1924 and 1930 are of no less importance. There would certainly be advantages in changing the basis of the index-number now, but there are also disadvantages, and the disadvantage I see at the moment is that within a year or so I hope to be able to re-weight the index-number on the basis of 1930, and a change of base now and again next year does not particularly appeal to me. I think it is essential that the index-number should be as nearly as possible continuous, and especially as the changes are shown to be of relatively small importance, I think we may very well go on for another year with the present weighting.

I have found the last part of Mr. Flux's paper particularly interesting. The literature on the subject at present is very meagre, and Mr. Flux's contribution to it is extremely valuable. In making a comparison of the price changes in the United States and United Kingdom, the selection of a base year, as Mr. Flux evidently realises, is a matter of some difficulty. Seeing that in 1928 prices were falling in the United Kingdom, but not in the United States, 1928 does not seem to me to be a very sound alternative base year to 1926; in fact I doubt whether it is really any better. In this country prices fell from the end of 1924 to the middle of 1926, when they rose considerably in consequence of the coal stoppage. They resumed their fall in 1927, with an index-number for the first quarter 2 per cent. below that of the second quarter of 1926. In the United States prices were falling continuously throughout 1926, and if there had been no coal stoppage here, I have no doubt that a similar course of prices would have been followed in this country. Had there been no increase in the second half of 1926 the index-number for that year would have been roughly 2 per cent. lower than it actually was. If you raise the base line to 102 instead of 100, the strain in prices

Mr. Flux mentioned as occurring between 1927 and 1930 is obviously very much reduced, in fact, in no year are the divergences from the base line of 102 entirely on one side of the line.

I should like to suggest to Mr. Flux that it would add very considerably to the value of his material if he could give us the relative variations in prices during the year 1926 as well as for the subsequent years. I think it would then be seen that the main strain in prices occurred not during the period he mentioned, but in the second half of 1926, and this strain was reflected in the fact that for 1926 we had an adverse balance of payments instead of our normal credit balance. There is a decreasing divergence of prices in 1930, and in that year we also had a decreasing balance of payments. In 1931 when there was a considerable adverse balance our prices had gone up in relation to those in the United States, and there was again a strain, the strain being reflected, as in 1926, by the adverse balance.

A continuance of this series would be of very great value and I should like to suggest to Mr. Flux that he should take the opportunity of continuing it as and when the material becomes available. I think Mr. Flux's data are of considerably greater reliability than the German data to which he has referred. I have looked at the original German diagrams and I find the relative movements of United Kingdom and United States prices as shown by these do not correspond with those found by Mr. Flux. The explanation is, I think, to be found in the footnote to the German diagrams, viz. "the original index-numbers for foreign countries have been set against the German index-numbers, which partly correspond to those of foreign nations in methods of compilation." Their figures only partly correspond; Mr. Flux's wholly correspond, and that is of great value in a study of the subject.

I have much pleasure in seconding this Vote of Thanks.

MR. NORMAN CRUMP said that he felt very glad to be able to thank Mr. Flux personally for the lead given twelve years ago, when he himself had embarked upon similar lines of research. On looking back over that period, numbers of little incidents might be recalled. The whole problem that the compiler of an index-number was up against was that the people who used it expected bricks to be delivered which were exact in size and weight to the last millimetre, and he was expected to be able to make those bricks with the help of such stuff as he could get hold of.

He would like to make one suggestion, to which he attached considerable importance. The British public took the wholesale price index-numbers and compared them with the retail index-numbers and those of the cost of living, and often proceeded to draw erroneous conclusions. If, instead of being described as a wholesale price index-number, it were called an index-number of primary materials and goods in the initial stage of manufacture, and then contrasted with the retail price index-number which really was a price index-number of goods which had reached their final stage, a great deal of misunderstanding in the minds of the

public and politicians would be obviated. Among other advantages, this change in nomenclature would save the class of the community engaged in the distribution and transport of goods from some unmerited reproach.

Mr. Crump's second point was that he had often wished to get out successful measurements of price changes in goods at various stages of manufacture, starting with primary materials such as raw cotton, wool, or pig iron, going on to cotton yarn, then to cotton cloth and, finally to such articles as cotton shirts. It was work where the straw was largely lacking and it left a very big gap between the prices of primary goods, which appeared in the wholesale price index-number, and the price of the final product, which appeared in the retail price index-number. Still, even working on wholesale price index-numbers an interesting point emerged, from the fact that the Board of Trade index-number for 150 items embraced a larger proportion of the more finished articles than an index-number such as that of the *Economist*, with only 57 items. What happened was that there were a certain number of raw materials and primary food stuffs that must be included in any index-number however many items it contained, and it followed that the more items there were in an index-number the larger was the preponderance of finished goods. As he had proved by an independent examination of three British index-numbers a short time ago, it followed that there was a more sensitive movement in the *Economist* index than in that of the Board of Trade. These facts suggested an interesting field for exploration.

On the question of international comparisons he had collected a fair amount of data and obtained some very interesting results, but if he once embarked upon discussing them, it would take up the rest of the evening. He had, however, one final point to make: it was perfectly obvious that if one simply confined oneself to calculations of prices of commodities entering into international trade, it would merely amount to checking the accuracy of the international deals in those commodities. He was not quite convinced what, if anything, would be proved if one followed Mr. Flux and calculated the price index-numbers of a similar list of commodities weighted in a similar manner, first in dollars and secondly in sterling. As an economic proposition he still had to be satisfied as to what if anything emerged from this calculation, and in these days, when people were trying to find the proper stabilisation rate, and seeking various good, bad, or indifferent bases of comparison, he thought this question ought to be further explored, as a matter of real importance.

Mr. Crump said he had been fortunate in having Mr. Flux to guide him through many years, and he welcomed this opportunity of paying tribute to him; he had been a worthy leader to all.

MR. MACROSTY said that as one of the collaborators with Mr. Flux in the compilation of the original Board of Trade index-number, it was perhaps not inappropriate that he should say that he had shared Mr. Flux's fears during the last few years as to the reliability of that old index-number under the changing circumstances which

had arisen from 1929 onwards, and he could scarcely express his relief when he saw the first draft of Mr. Flux's calculations and found that for a greater part of that period the new weighting which they had discussed together had not materially affected the trust which could be put in the old index-number. He felt that Mr. Flux and he could congratulate themselves upon the skill with which they compiled that old index-number, or the luck with which they met in those working papers which had so mysteriously disappeared. Whether a matter of skill or luck, it had now been proved that it was a very good index number.

Mr. Macrosty drew attention to the table in Appendix II where the effects of the weighting of the 1907 and 1924 distributions were set out for the period 1925-1932. It would be found that from 1925-1929 the re-weighting made no practical difference except in the year 1926. In that year quite a sharp difference was shown which seemed to show that both the 1907 and the 1924 distributions of the relative importance of industries were deflected by the independent movement of prices of commodities in that year. To his mind that showed that for any purposes of international comparison it would be unwise to take 1926 as a base year for this country. As Mr. Flux had pointed out, in 1931 and 1932 there was a sharp divergence in the effects of the weighting. That might mean simply that the 1907 weighting had got completely out of relation to the economic structure of the latter two years, or that the 1924 weighting had also got out of gear, but in either case it seemed that Mr. Leak had good reason for holding his hand until he got the results of the Census of 1930, when he would be in closer relation to the economic facts of the last three years.

With regard to the second part of Mr. Flux's paper, Mr. Macrosty found it rather difficult to speak. Mr. Flux had given them a Pisgah view of a territory which had been but little explored and the means of getting across into it were rather uncertain, but he had made a considerable addition to their knowledge, and had pointed out some new methods of exploration. This section confirmed him all the more in the shyness he experienced whenever anyone proposed to use an index-number of wholesale prices as a means of stabilising, regulating, or controlling currencies or credit. With all the skill that might be used the methods of calculating a wholesale price index-number were still rather rough. Personally he would be satisfied if in compiling an index-number no quotation varied from accuracy by more than a plus or minus 5 per cent.; most of the quotations in the Board of Trade index-number were better than this, but he doubted whether such a standard was fine enough for dealing with currency, and more particularly for dealing with international currency. In that connexion it was necessary to consider very closely the important articles that entered into international trade and their relative importance in the different countries, and to scrutinise very carefully the individual price movements as well as the movements of any combinations of them taken together.

Mr. Macrosty had great pleasure in supporting the vote of thanks to Mr. Flux for his valuable paper.

PROFESSOR J. H. RICHARDSON wished to add his tribute of thanks to those already offered to Mr. Flux for the lead he had given in the development of British statistics and also for carrying his lead into the international field. From experience gained in the International Labour Office he was able to furnish evidence which tended to confirm Mr. Flux's conclusion that to cover a long period of years by an unchanged index was likely to give erroneous results. The problem had been faced from a different angle by the International Labour Office. They were not comparing price statistics for the same place at different periods of time, but were making spatial comparisons of retail price levels in different countries at the same date, and the problem immediately arose—in what countries were habits of consumption sufficiently similar to justify their being included in the same series? The number of countries which could be brought into a single comparison was determined by the adequacy of the common elements which could be incorporated in the series. Where the standard of consumption of any country varied widely from that of other countries, it became necessary to exclude it from the comparisons, or to consider forming another group of countries into which it would fit.

Professor Richardson asked Mr. Flux if he could give any criteria as to when the commodities and weights upon which an index of price changes was based should be modified. It was evident that in periods of rapid change in production and consumption there would be need for more frequent adjustments, and the life of the index number would be shorter in certain periods than it would be in others. It would be valuable if some indication could be given as to the criteria by which to determine when a change would be justified. The mere availability of data from which to establish new weights was not enough; more scientific criteria were needed.

Professor Richardson expressed special interest in the question of the use of price indexes as one of the series considered by those responsible for monetary and credit policy. He appreciated the statistical difficulties in the way of compiling satisfactory price indexes, but from a practical point of view in dealing with the affairs of the world the series available, though imperfect, were being used, and would continue to be used. The statistician, if he compiled such series at all, could only try to improve their quality and point out the margin of error to which they were liable.

Another point upon which it might be useful if Mr. Flux would give his opinion, was whether he considered that there would be any value in the establishment of an international index which would bring together in one series data for several countries similar to those which he had already worked out for Great Britain and the United States. Would such a series be of any practical value? His own view was that there would be little value in making such an average, although other methods of compiling an international average might be considered.

It would also be interesting to have some indication as to the main reasons why divergences arose between the price movements shown by the indices of two or more countries over a period of time.

In his opinion such divergences often reflected restrictions of various kinds, whether due to economic or political causes, upon the ordinary course of international trade. Reference had been made to divergences in 1926 when British trade was artificially restricted, and in 1930 and 1931 when there was a great increase in barriers to international trade and in currency restrictions. Were not divergences in the price indexes of different countries to a considerable extent a measure of such restrictions?

Professor Richardson had great pleasure in paying his tribute to the reader of the paper.

MR. GAMPELL asked Mr. Flux whether the quantities consumed in the United Kingdom, whether quantities in 1907 or quantities in 1924, were at all appropriate to an index of the prices registered on the wholesale markets of this country. Fellows might be acquainted with Dr. Alonzo Taylor's paper on "Speculation, Short Selling and the Price of Wheat" which appeared as Vol. VII, No. 4, of the *Wheat Studies* of the Food Research Institute of Stanford University, California. It was there stated that "Liverpool futures register the basis on which there is conducted an international trade in wheat approaching or exceeding half a billion bushels." That was half of an American billion only, but even so it was more than double this country's imports, and more than nine times the imports of the Mersey ports. If Liverpool futures register the basis for 500 million bushels, then the weight assigned to them should be 500 million bushels—particularly in an index which purports to register the price-level of those commodities whose interchange is conducted by means of this country's currency. In practice, the Board of Trade assign no weight at all to them, though a series which is some sort of reflection of those futures is assigned a weight of about 30 million bushels by the Board. If our markets were admitted to be international rather than internal, then the relative importance attaching to the individual markets in the construction of an index should be based upon the relative importance of the various commodities in international trade and not in this country's consumption.

Presumably the Board might defend its procedure on grounds of international consistency. Other countries, America for instance, used the internal consumption standard in their index-making, so that if we used an international standard we should be in a class by ourselves. But our markets were, in fact, in a class by themselves. Formal international consistency appeared to be a pitfall rather than a guide. It had led Sir Walter Layton, at the discussion of Mr. Flux's previous paper in 1921, to advocate the arithmetic and to deplore the geometric average, solely because other countries used the former and poorer procedure.

The omission of gold and of silver from the Board's index called for remark. The value of the annual output of the yellow metal, regarded purely as a mineral, far exceeded that of any other metal. The distribution of almost all that output was negotiated in London and financed in sterling. If the changing prices on the London

bullion market were not included in the Board's index they could be included in no other country's, since London was in the position of possessing the only recognised open market in the commodity while New York was in the stage of contemplating the possibility of establishing one. Yet the Board does not consider that market worthy of one single quotation—not even for such weight as might attach to it on the mere consumption standard for such purposes as the filling of teeth, which purposes, as he gathered from the literature on the subject, were known as “the arts.” He presumed silver was omitted as being also a precious metal, but in view of the prices at which it had recently been selling the word “precious” appeared to require some qualification.

He would like to conclude by mentioning a matter which might be of some practical interest. Fellows might have noticed that there had recently been published a daily index of prices in the United States. He was informed by Reuters that a daily index for the United Kingdom was in preparation and perhaps it might prove to be of utility to the Fellows of the Society.

MR. FLUX, in reply, said: I should like to thank those present for the reception that they have been kind enough to give me to-night, and in dealing with the points raised I want in particular to put myself right with my old friend Mr. Yule. In the paragraph of my paper with which he disagreed, I referred to particular uses that the long-period index-number was made to serve, and it was in that connection that variation by change of base suggests the possibility of serious effects on the reliability of the calculations made. The changes of emphasis that are appropriate from time to time are not wholly likely to be such as would preserve the original series unchanged. Remembering what the other element in that comparison is, it seems quite possible that the kind of variation to which I alluded, though not very important in some other connections, might be important there, just as Mr. Macrosty expressed the view that it might be important in an index-number that was to be a serious guide in the regulation of foreign exchange. My Manchester paper shows that I was not forgetful of the fact that the change of base year involves, in effect, a change of weighting.

I think that, for the purpose to which I was alluding, *i.e.* for demonstrating some connection between price movement and some other phenomenon, that the use of the long-period index-number, calculated on an unchanged formula, may yield less trustworthy results than those reached if the base is changed from time to time. When we are trying to get a measure of the importance of price fluctuations over the short period in which we are living,—the few years last past, and the few years to which we are moving—I think it is desirable that we should, as far as possible, eliminate causes of misleading registration in the index-numbers; it is for that reason that I suggested the desirability of re-examining our basic data at more or less regular intervals.

I was asked what period I would consider for such revisions. Without wishing to be frivolous, I was a little inclined to ask the

question—How often should a mother insist upon her small son washing his face? I think that, whatever the conditions, the normal mother insists on a wash twice a day at least, as an absolute minimum, but would regard more frequent ablutions, say, before each meal, as likely to be beneficial. An annual overhaul of the structure of an index-number of wholesale prices is, perhaps, hardly a practicable proposition, but an overhaul at intervals of not less than ten years might be prudent, so as to be ready for changes that may come in a future that is not very far distant.

With regard to the use of the year 1926 as base year in the calculations of the latter part of the paper, I should like to refer to Appendix II and to point out that the actual average of the Board of Trade index-number for 1926 lies, as nearly as possible, half-way between those for 1925 and 1927, and, from the point of view of a factor to reduce the index-numbers of other years to a common basis, it does not look as if the use of the 1926 figure can have introduced much distortion. All that has been done there has been to take the actual logarithms of the index-numbers and deduct the logarithm of the average index-number of 1926. If that average shows no sign of exceptional deviation from the averages of preceding and following years we should not expect to introduce distortion by that process.

It is only from the beginning of 1927 that the data, from which I had the chance of making a selection, have become available, the range of the published information being much more limited for dates before and during 1926 than for those in and after 1927. Although an adequate selection might be made, it would be necessary to resort fairly freely to the method which, as I pointed out, I had to use in a few cases—of taking the same price series more than once. The other alternative was to follow the Americans and use prices of manufactured commodities, which would introduce a definite source of non-comparability.

In carrying out the calculations for 1931, I found that the data published by the United States authorities for 1931 are less comprehensive than those published for 1930. This fact increases my reluctance to attempt the calculations for 1926 and earlier years.

I should like to say one word with regard to a remark that fell from Mr. Crump. He has encouraged me to believe that my calculations may prove to be significant, as I hoped they might be, and in showing that possibly they might have been even more significant if they had been different in certain ways that he indicates.

The discussion this evening disposes me to somewhat greater boldness, in one particular respect. Our price index-numbers are, of course, very far from complete measures of price variations, but, if the elements composing them are well selected, they may reflect satisfactorily the effects of the aggregate of price movements. In the case of international comparisons, we have to face the fact that, with identical movements of individual prices in different countries, the true average movements would not necessarily be identical in those countries, unless the price movements in the principal commodity groups happened to be parallel. It is this that gives import-

ance to such calculations as those to which I have made a small contribution. They appear to indicate that, while much of the divergence between the price indices of different countries is due to the different commercial and industrial structures of those countries, there has been, since the war, a quite notable amount of price divergence apart from that which results from differences of economic structure. If this is confirmed by further enquiries, it appears to mean that the operation of a metallic standard of value identical in different countries cannot ensure that prices in those countries are kept from important variation. In view of the narrow limits of the specie points in exchanges between gold standard countries, such divergences in price levels as 5, or even 3, per cent., appear far from insignificant. It would, in fact, appear that the link between currencies afforded by convertibility of each into gold at a fixed rate cannot, taken by itself, be relied on to ensure a closeness of agreement between average price movements within several times the range indicated by the specie points. If that be so, the stability of domestic price movements in each of several countries may be definitely inconsistent with the stability of exchange rates between them.

Another point that was raised, was the inappropriateness of weighting where we did not take account of the full turnover of speculative markets in the country. I can conceive of a hundred different procedures in determining weights which would be almost equally defensible. There happens to have been chosen one procedure, and I do not mind if anyone says that from his point of view it is not perfect. This evening my concern has been, not with making a new index-number, but with examining the extent of change in an existing index-number which follows from the application of principles laid down when that index-number was established. If the idea suggested to me is that something like the plan carried out in the United States index-number should be followed, I have a remark to make upon it. An effort is made to estimate the total turnover in the country of each individual commodity, the price of which is known, or of a group of commodities which a price is taken to represent, and to weight the index-number in accordance with the turnover in that way. I have the gravest doubts as to whether the information could be procured by private persons, or even by public authorities, or whether such data as could be secured would be reliable. It would be very expensive to compile and would take a long time, and I am not disposed to believe that it would give us a weighting that would be more reliable than that which happens to have been chosen. I am not claiming perfection for that scheme of weighting; I can claim that it was a scheme that has appeared to some other workers in the field to be a useful one, and to be one that they could approve accordingly.

As to the suggestion that gold and silver should be included, the gold suggestion in particular seems to me to be a very remarkable one. It might be an appropriate suggestion in the Union of South Africa, but in this country I do not quite see why we should include the metal which is the means of measuring our prices. It is true

that the index-number of the Board of Trade has been calculated in periods when gold was not the measure of our prices, so that what I have just stated might be countered by a reminder of that fact; but I should be content here to follow the example of our old colleague, Sauerbeck, who, in setting out the data from which he had compiled his index-number, gave alongside them the course of movement of silver prices.

Some of us will remember that an honoured American colleague announced that the formula he favoured would assure him an index-number true to within less than $\frac{1}{2}$ per cent. I am not disposed to claim that that degree of precision has been obtained in the records of prices that were used as the fundamental data in our combination, though in taking broad averages we may escape some of the worst evils of that degree of uncertainty. Some prices are ascertainable with even greater precision than a possible error of $\frac{1}{2}$ per cent. implies, but an index confined to such prices would not reflect the general movement of wholesale prices, except by accident.

As the precision of measurement that may be looked for from price indices has been referred to, I should like to say that, in references to possible variations of 5 per cent. either way, I take it that it is not meant to imply that an index of 100 is fully satisfactory as a representation of something not less than 95 or more than 105, but that, if the index is 105, showing an advance of 5 per cent. on the basis from which measurement proceeds, it is intended to imply that the figure 105 represents something between $104\frac{3}{4}$ and $105\frac{1}{4}$. In other words, the deviation from the base figure is claimed to be measured truly to within 5 per cent. of itself. That, perhaps, brings us within reach of our American colleague's claim, and such a degree of precision might render the index-numbers useful even as guides to currency regulation.

Professor Richardson raised one or two quite interesting points, with one of which I have already dealt. He put another interesting question to me, and that was whether I thought an international average would be useful? I am interested in the kind of comparison to which I tried to make an addition to-night, because it seems to me that we are in danger of having some wholly unintelligible and unmeaning international averages thrust down our throats unless we will adopt some measure that will get us over the difficulty arising from the calculation by each country of an index-number relating to its own conditions. We need to know how much of the divergence between our index-number and that of another country is due to divergence in the plan of computation and in the range of material used.

That is all I would venture to say to-night, other than to thank you again for the cordiality with which you have welcomed an old colleague.

MISCELLANEA.

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PRODUCTION, OUTPUT PER HEAD, PRICES AND COSTS IN THE IRON
AND STEEL INDUSTRY, 1924-1931.

(Frances Wood Memorial Prize Essay, 1932.)

By R. W. B. CLARKE, B.A. (Cantab.).

THE objects of the essay are twofold : first, to discover a functional relationship between production and output per worker in the iron and steel industry ; and second, to measure the costs of production of pig iron, quarterly, and to compare them with the selling price. The course of the argument is as follows :—

- I. An index of employment is calculated by a method based on that suggested by Mr. C. G. Clark in *J.R.S.S.*, 1929.
- II. A functional relationship is found between the production and the output per worker.
- III. The course of production is estimated for those branches of the industry for which no production figures are available.
- IV. An estimate is made of the displacement of workers by rationalization.
- V. Variations in wages in the pig iron industry.
- VI. The selling price of pig iron.
- VII. The prime costs of production are estimated, quarterly.
- VIII. The selling price is compared with average and marginal prime costs.

(The essay has been considerably condensed for publication : much of the detail, particularly in Sections II, V, VI, and VII, has been omitted.)

I. THE CALCULATION OF AN INDEX OF EMPLOYMENT.

There are three steps in this calculation : (a) calculation of a monthly index of the number of insured persons, (b) subtraction of the unemployment percentages, and (c) extraction of the seasonal variation.

(a) *The monthly index of insured persons.*

The number of insured workers at the end of June is published annually by the Ministry of Labour. The difference from year to year is made up of new entrants, minus "gross losses," *i.e.* deaths, retirements, transfers to other industries, etc. The number of new entrants was provided quarterly by the Ministry of Labour, so that the gross loss for each year is known; *e.g.* for the pig iron industry, in June 1924 there were 30,190 insured workers; this, plus new entrants, gave a total for June 1925 of 30,550. The actual number in June 1925 was 25,780, so the gross loss for the year was 4,770. The gross loss is then spread over the whole year by a quarterly interpolation of a freehand cumulative curve of the gross losses for the whole period. Thus an estimate is made of the number of insured workers at the end of each quarter. These figures are expressed as index-numbers; the data up to September of any year are based on the June of the previous year, *e.g.* the figures from October 1924 to September 1925 are based on June 1924 = 1,000. A monthly index is then obtained by linear interpolation.

(b) *Subtraction of unemployment percentages.*

Now the unemployment percentages up to September of any year refer to the number of insured persons in the previous June. The unemployment percentages can therefore be subtracted as they stand from the indices obtained above, leaving an index of employment, each monthly figure of which is based on the previous June. The series is then re-based on the average of 1924 = 1,000; and the required index is calculated.

One important administrative change was made in the period 1924-31; workers between the ages of 65 and 70 were removed from the scheme. The index can be made continuous, for figures were published showing the number of insured persons in June 1927, both between the ages of 16 and 65, and of all ages. To get the number of employed persons in any month before June 1927, the index, in the pig iron industry, must be multiplied by 29,610; and after June 1927, including only workers from 16 to 65, by 27,750.

(c) *Extraction of seasonal variation.*

The differences Jan.-Dec., Feb.-Jan., . . . Dec.-Nov., are calculated, and the medians of the Jan.-Dec. changes, of the Feb.-Jan. changes, etc. are determined. A constant is added to each in order to make the sum of the medians zero; and the medians are then cumulated in order to find the difference of each month from January. A further constant must then be added to make the sum of these

differences zero, and the resulting figures are those which must be subtracted from the original series to eliminate seasonal variation.

In the pig iron industry there is a slight seasonal variation, showing that the activity of the industry is greatest in the first half of the year; there is no *prima facie* reason for this, and the most likely explanation is that in the period 1924-31 the iron and steel industry has usually been depressed in the second half of the year, because of external causes: *e.g.* the re-entry of Germany into world production in the latter part of 1924, the coal stoppage in 1926, the reaction from the activity of the beginning of 1927, and the collapse of 1930. The method is only shown for the sake of completeness.

(d) *Other derived series.*

The monthly index of insured persons obtained in (a) can be re-based on the average of 1924 = 1,000, giving a series showing the changes in the number of insured persons. The long-period movements of the industry are clearly illustrated by this curve.

A true unemployment percentage can also be calculated for each month; this curve shows the short-period fluctuations of the industry, and is far more useful than the unadjusted Ministry of Labour percentage, which is often very misleading in rapidly expanding or contracting industries.

The method used in calculating this employment index has only one source of error—the interpolation of the cumulative curve of gross losses. This may involve an error of as much as 1 per cent., but it can fairly be claimed that no other method will give a better result.

II. THE RELATION BETWEEN PRODUCTION AND OUTPUT PER WORKER.

Indices of employment obtained in Section I are now correlated with figures of production in the iron and steel industry, as far as they are available.

(a) *The pig iron industry.*

The monthly figures of production published by the National Federation of Iron and Steel Manufacturers are reduced to daily averages (blast furnaces work every day; in 1924, 97.7 per cent. of the shift workers worked a seven-shift week). These daily averages are expressed as an index based on 1924 = 1,000, and thence an index of output per head is obtained. The output per head curve shows similar fluctuations to those of the production curve, especially from 1927-1931: it also has a distinct upward trend, showing the effect of technical improvements.

A comparison of the curves suggests that a relation exists between the production and the output per head of the form $y = kt + f(x)$, where y is the output per head, x the daily production, and t is the time-element, to allow for the upward trend of y . (When monthly data are used, $t = 1$ in Jan. 1924, $t = 2$ in Feb. 1924, etc.) The function $f(x)$ may be assumed to be of the form $a + Ax^m$. The data from 1927-1931 are then analysed in order to determine the most probable values of the constants a , k , A , and m . This is done by the method of least squares; y is taken as the dependent variable, subject to small errors, while t and x are known exactly. A relation of the form $Y = a + kt + Ax^m$ is therefore determined, in such a way as to make $\Sigma(y - Y)^2$ a minimum. Differentiation of $\Sigma(y - Y)^2$ with respect to a , k , A , and m gives four equations, which cannot in this case be solved. It is therefore necessary to guess a value for m , say M . Then, if $x^M = X$, the problem is resolved into one of finding the conditions that $\Sigma(y - Y)^2$ should be a minimum, where $Y = a + kt + AX$. The constant a is eliminated by referring the co-ordinates to their means, \bar{y} , \bar{t} , \bar{X} , as origins. If the new co-ordinates are y' , t' , and X' , then the values of k and A are given by the equations:—

$$\Sigma y't' - k\Sigma t'^2 - A\Sigma X't' = 0.$$

$$\Sigma y'X' - k\Sigma t'X' - A\Sigma X'^2 = 0.$$

Subject to these conditions, $\Sigma(y' - Y')^2 = \Sigma y'^2 - k\Sigma y't' - A\Sigma y'X'$, and the standard deviation σ is given by $\sigma^2 = \frac{1}{n}\Sigma(y' - Y')^2$, where n is the number of observations.

In view of the fact that the solution is one of trial and error for the determination of m , the quarterly data were used, with the following results:—

m	σ	k	A	a
·4	30·8	6·06	66·81	53
·5	20·1	7·97	32·77	50
·55	20·0	8·05	21·48	126
·6	19·4	8·03	14·09	197
·7	20·2	7·83	6·13	317

This result shows that M lies between 0·5 and 0·7, and is probably about 0·6. As accurate a result as is desired can be found by continued "bracketing."

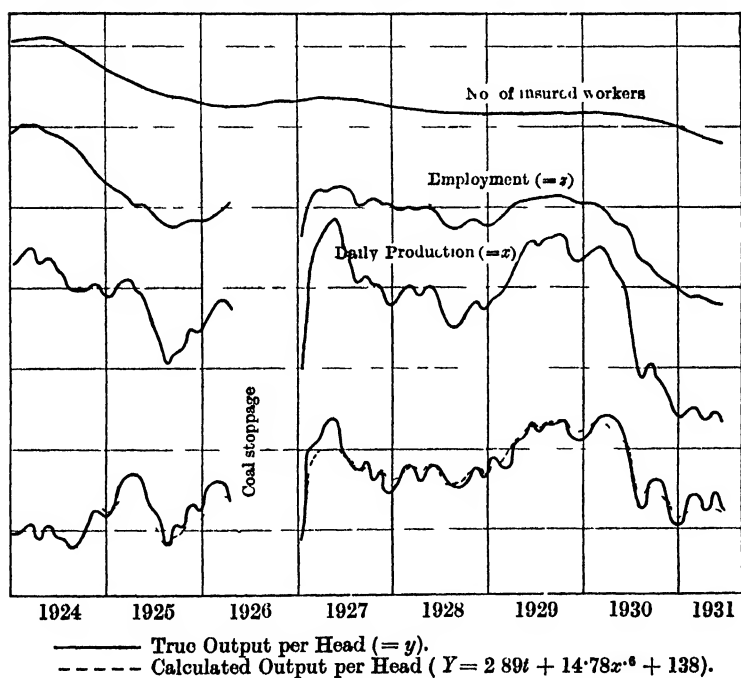
It is now necessary to calculate the probable errors of k and A . This is done by "Student's" method, which is explained in detail in "Statistical Methods for Research Workers," by R. A. Fisher.

For $M = 0.6$, the probable error of k is 0.83, and that of A is 0.60; a reasonably small margin of error.

The approximate value of M has now been determined from the quarterly figures; we can thus assume that $M = 0.5$ or 0.6, and thence calculate the values of k and A from the monthly data. The resulting equations are: $-y = 2.92t + 34.73x^{\frac{1}{3}} - 27$, with a standard error of 26.75, and $y = 2.89t + 14.78x^{\frac{2}{3}} + 138$, with a standard error of 26.6. These figures, of course, only refer to the period

DIAGRAM I.—Production, Employment, Output per Head in the Pig Iron Industry.

(One vertical division represents a variation in the indices of 25 per cent.)



1927-31. The probable errors of the coefficients k and A , for $M = 0.6$, are 0.20 and 0.42 respectively. The accuracy is, of course, improved by increasing the number of data.

These equations demonstrate the increasing return from labour in the industry, and also the rapid increase in output per head due to rationalisation.

(b) *The manufacture of steel.*

For the second stage of the process—the conversion of pig iron into steel ingots—the statistics are not so reliable. The N.F.I.S.M.

publishes figures of the monthly production of ingots and castings, and also of a wide range of finished steel products, but the Ministry of Labour unemployment statistics do not separate workers engaged in steel melting, iron puddling, and iron and steel rolling and forging. Comparison of an index of the production of finished goods with that of ingots and castings shows, however, that the error involved in taking the production of ingots and castings alone as a measure of the activity of the steel industry is quite small.

An index of the average daily production of ingots and castings is therefore calculated (from the number of *working* days in each month), and is compared with the employment index. Using the monthly data, for the whole period 1924-31 (excluding the 1926 coal stoppage), with the same notation as before, the equation is $y = 323 + 3.33t + 0.645x$ with a standard error of 48.0. The probable error of k is 0.14, and of A is 0.02. The production of steel is therefore also subject to increasing return as far as labour is concerned.

(c) *Other branches of the industry.*

Production and employment figures are both available for the tinplate industry, but the fluctuations of both of the curves are so great that no accurate result can be obtained.

There is no other branch of the industry for which both production and employment figures can be got; in Section III, the production of iron and steel tubes is estimated from the employment figures.

It is possible from these equations to estimate in advance the number of men required to produce a given output, or alternatively to estimate the employment over periods for which employment figures are not available. The course of employment in steel manufacture can thus be estimated from 1920 to June 1923 (when the present industrial classification was started); and estimates of the changes in the number of insured workers since the latest June count can be made. In Sections III and IV, other important deductions are made from the equations.

III. AN ESTIMATE OF THE COURSE OF PRODUCTION WHERE INTER-CENSAL FIGURES ARE NOT AVAILABLE.

For many industries for which employment figures are available the only production data are those of the Census of Production. If the production and employment in some industry in the same industrial group are known, it is now possible to estimate the course of production in the inter-censal years. We take, for example, the *wrought iron and steel tube* industry. It is assumed that the form of the

relation $y = kt + f(x)$ is the same for this industry as for the manufacture of steel, and the constants are determined from the known production of iron and steel tubes in 1924 and 1930. The curve $y = kt + Ax^m$ is fitted for the steel industry, and it is found that $m = \frac{1}{2}$. (*N.B.*—This fitting is a restriction on least square procedure, but if a constant a is included, we have three constants, and only two known sets of data; 1924 and 1930.) Thus, the equation for the iron and steel tube industry is taken as $y = kt + Ax^{\frac{1}{2}}$, and the values of k and A are found to be 1.72 and 31.50 respectively. If the employment index is z , we therefore have: $\frac{x}{z} = 1.72t + 31.50x^{\frac{1}{2}}$, a quadratic equation in $x^{\frac{1}{2}}$, which gives the production in any quarter when the employment is known.

In order to get some idea of the error involved, the constants k and A were calculated for the pig iron industry from the Census data only. The resulting equation showed a probable error of about 5 per cent. Although there may be error in assuming that the form of the equation is the same for all members of an industrial group, the results must be better than results based on the assumption that production varies directly with employment.

IV. THE EFFECT OF RATIONALISATION ON EMPLOYMENT.

The results of the previous sections are now used in order to estimate the number of workers displaced by rationalisation since 1924; *i.e.* the difference between the number of workers required to produce the same output in 1924 and in 1930.

Let the number of workers required to produce the 1924 output in 1930 be z (an index, based on 1924 = 1,000). Then, for the *pig iron industry*, substituting in the monthly equation, with $x = 1,000$, and $t = 78.5$ (the average for 1930), we have:—

$$\frac{1000}{1000^z} = 138 + 2.89 \times 78.5 + 14.78 \times 1000.6 = 1298 \pm 18.$$

$$\text{whence } z = 770 \pm 10.$$

The number of workers displaced is therefore $25,430 \times .230 = 5,850 \pm 250$. The index of employment in 1930 was 694, so if the production had been up to the 1924 level (an 18 per cent. increase), only 1,930 workers would have been absorbed. The number of unemployed in 1930 was 5,630, so that even then there were 3,700 surplus workers compared with 1924.

This displacement has taken place in three ways: (a) by the scrapping of obsolete furnaces and the building of larger ones, (b)

by the introduction of machinery (*e.g.* mechanical charging), and (c) by co-ordination of the processes of manufacture. The output per furnace in blast increased by 30 per cent. from 1924 to 1931, and 126 obsolete furnaces have been scrapped. The number of workers per blast furnace has not increased, a sign of the operation of (b) and (c) above. The incidence of (b) is also demonstrated by the 16·1 per cent. increase in the mechanical power available in blast furnaces and steel rolling mills from 1924 to 1930.

The number of workers displaced in the *steel melting, iron puddling, iron and steel rolling and forging industry* is 30,260, with a probable error of 2,280; and if production had risen to the 1924 level, only 8,300 more workers would have been employed. The average unemployment in 1930 was 63,530, so there were then about 55,200 surplus workers.

V. WAGES IN THE PIG IRON INDUSTRY.

There are three important sources of information regarding wages in the pig iron industry: (a) the monthly statements of wage changes in the *Labour Gazette*, (b) the earnings investigations of the Ministry of Labour in 1924 and 1928, (c) the N.F.I.S.M. earnings figure published quarterly from 1924 to 1928.

The results of (b) and (c) are compared in the following table:—

Week ending	Weekly earnings.		Number of workers.	
	Ministry of Labour.	N.F.I.S.M.	Ministry of Labour.	N.F.I.S.M.
1924. Jan. 12	63/5	64/11	28,752	23,294
Apr. 12	63/8	65/5		22,076
July 12	63/1	64/3		21,779
Oct. 18	62/4	63/11		20,321
1928. Oct. 27	59/1	60/8	17,174	19,902

The Ministry of Labour figures cover a far greater number of workers than are included in the unemployment statistics; the N.F.I.S.M. figures include coke oven workers attached to blast furnaces (which accounts for the higher rate). The Ministry's figures may be taken as the average weekly earnings in 1924, and the N.F.I.S.M. figures are used as a quarterly index (as it stands, it refers to selected dates at the beginning of quarters, but it can easily be adjusted as a quarterly average). It should be noted that the investigations agree upon the amount of the fall in earnings from 1924 to 1928, which supports the view that the N.F.I.S.M. figure, when adjusted, can be used as an index-number for earnings.

Unfortunately, the N.F.I.S.M. figures were discontinued after

1928; the index is therefore extrapolated for the period 1929-31 according to the movements of an index of labourers' wage-rates, the method of construction of which is now explained. In passing, it may be noted that there is no great difference between earnings and wage-rates in the pig iron industry, for no short time is worked.

According to the 1921 Census, there were 54 classes of worker in the industry, each of which has a different wage and bonus system; so it is impossible to get a wage-rate for pig iron workers as a whole. An index of labourers' rates is therefore constructed.

Wages are regulated by sliding scales dependent upon the selling price of pig iron. A standard price and a standard wage are fixed, and for every variation from the standard price, a certain percentage is added to or subtracted from the standard wage. For these agreements, the country is divided into nine districts: the *Labour Gazette* gives, for each district, the changes in the percentages added to standard rates by virtue of changes in the ascertained price. Series can therefore be made showing the changes in labourers' wages over the whole period; and these are then combined to make an index of labourers' wages for the whole country.

The number of workers in each district in 1924 is estimated from the 1921 Census, together with the changes in the proportions of the national output produced in each district from 1920 to 1924. It is not sufficient to weight the district wage-series according to the number of workers in 1924: there have been considerable changes in the distribution of the industry since then. For example, the importance of the Midlands has increased and that of Scotland has decreased. It is assumed that, while output per head is by no means the same in all districts, it has changed according to the same law in all districts. The employment in each district for each quarter is calculated from the quarterly production in that district, using the equation of Section II. The resulting figures are then corrected in order to make the total number employed in all the districts the same as the known employment in the whole country. This gives the employment in each district, so a weighted index can be constructed, giving the movements, for the whole country, of the labourers' wage-rate.

A comparison between this index and the corrected N.F.I.S.M. index shows that the difference is greatest when output per head is greatest; this might be expected, for the bonuses paid are then highest.

VI. THE SELLING PRICE OF PIG IRON.

The average selling prices, at the furnace, of the four chief types of pig iron (basic, hematite, foundry and forge) are given in

the Census of Production for 1924 and 1930. The inter-censal gap is interpolated quarterly from the ascertained price statistics published by the Ministry of Labour in connection with wage changes. The prices of hematite and basic pig iron are assumed to vary in the same way as the ascertained prices of "West Coast hematite mixed numbers" and "Lincolnshire pig iron" respectively; the price of foundry and forge pig iron to vary with an average of "Cleveland no. 3 foundry," "Notts pig iron," and "Northants pig iron."

The total revenue from the sale of pig iron for each quarter, and an average selling price of pig iron can then be calculated directly, for the amount of each type of pig iron produced is given by the N.F.I.S.M.

There are no separate monthly figures for the production of ferro-alloys, iron castings, other types of pig iron, and such by-products as slag, cement, and gas. The total value of these is known for 1924 and 1930, and it is assumed that the revenue from these will vary with the total revenue from pig iron. Thus the *gross revenue*, quarterly, of the whole industry is obtained, and this, divided by the total production of pig iron and ferro-alloys, gives the gross revenue per ton produced.

VII. THE COSTS OF PRODUCTION OF PIG IRON.

Costs of production can be divided into three headings, (a) labour (including social insurance), (b) raw materials and the transport thereof, and (c) overheads.

(a) *Labour costs.*

An index of labour costs per ton is given directly by $\frac{w}{y}$, where w is the N.F.I.S.M. wage index, and y the output per head. The average of labour costs per ton in 1924 was 11s. 5d., according to the returns of firms producing 58·7 per cent. of the national output for the 1924 Census; this figure is taken as the base. The employers' contributions to unemployment and health insurance are known throughout the period: assuming that the proportion of boys in the industry is the same as that in the iron and steel industry as a whole, the contribution was 1s. 2½d. per week per worker from Jan. 1924 to Dec. 1925, and 1s. 4·40d. from Jan. 1926 to Oct. 1931. An index of costs per ton is easily obtained from this, and the output per head; the base in 1924 was 2·48d. per ton. This corresponds well with the statement of one firm in the 1924 Census to the effect that social insurance was 0·205 per cent. of his costs. The gross revenue in 1924 was 100·6 shillings per ton, which gives nearly exactly the same result as our calculation.

(b) Raw materials and their transport.

Statistics of the consumption of British and imported iron ore, coal and coke, limestone, and other materials (cinder, scale, purple ore and scrap) are published annually by N.F.I.S.M. These are available from 1921-30, but as three abnormal years, 1921, 1922, and 1926, are included, it is impossible to say whether or not the consumption of fuel and ore per ton of pig iron produced is dependent upon the production of pig iron. It is assumed that the consumption per ton is independent of the total production.

The annual data are interpolated quarterly in order to estimate the quarterly consumption of fuel and ore. The c.i.f. price of imported ore is given in H.M. Customs Returns, and the price of British ore, at the mine, is given in "Output of Metalliferous Mines and Quarries." The price of coke, at the oven, is given, for 1924 and 1930, in the Census of Production; and the price in the intercensal period is obtained by interpolation on the basis of the export price. The cost of fuel, and of iron ore, per ton of pig iron and ferro-alloys produced, is thus known quarterly over the whole period. The Ministry of Mines publishes annually the weight and value of limestone consumed in blast furnaces, and the cost of this, per ton of pig iron, is got quarterly, by interpolation.

These costs refer to the price of the material at the seaport, mine, or coke oven. The only sources of information about transport costs are the monthly railway statistics and the investigations of the Balfour Committee in 1925. Transport costs vary with the location of the industry; the Balfour Committee found that, while in Cleveland, the cost of transporting raw materials was about 17s. 2d. per ton of pig iron, in South Yorkshire it was only 10s. 2½d.

The amount of iron ore carried, and the receipts therefrom, are given in the monthly railway returns. Practically all of the iron ore carried is used in blast furnaces, so the cost of rail transport of ore per ton of pig iron produced is determined. There have been two investigations of the average haul of ore, and it is worthy of note that the length of haul has increased from 41.17 miles in July 1925 to 44.93 in March 1928. This is due to the increased use of British ore, and to the approaching exhaustion of Cleveland ironstone and the substitution of Northants ore. About 30 per cent. of the ore used is carried by road or by canal, and the cost of this will have to be guessed.

There is a special division in the railway statistics headed "Limestone for use in steel works and blast furnaces," which gives the cost of transport of limestone.

The average length of haul of coal and coke is estimated as 40 miles; the cost of transporting fuel is therefore determined,

for the weight of fuel consumed, and the cost of transport per ton-mile, are both known.

The cost of the other materials, of road transport, and of handling costs, cannot be determined separately, but a composite "remainder" figure is obtained from the Census of Production.

Cost of materials in shillings per ton of pig iron.

			Census figure.	Costs already determined.	Other costs.
1924	...	...	85.07	72.53	12.54
1930	...	...	63.56	55.51	8.05

The "other costs" are assumed to vary in the same way as the costs already determined, in the 1924-30 period. Thus a figure of the total cost of materials per ton of pig iron and ferro-alloys produced is calculated quarterly.

(c) Overhead costs.

The estimate of overhead costs presents many difficulties, and since overheads do not enter into the short-period price, they are not considered here.

VIII. THE RELATION BETWEEN PRICES AND COSTS.

It is now possible to calculate the marginal prime costs and to compare them with the selling price. At any time, let the gross revenue per ton of pig iron be P , the cost of materials p , and the cost of labour per man-shift W ; then, if an increment of production dx involves an increase in employment of dz man-shifts:—

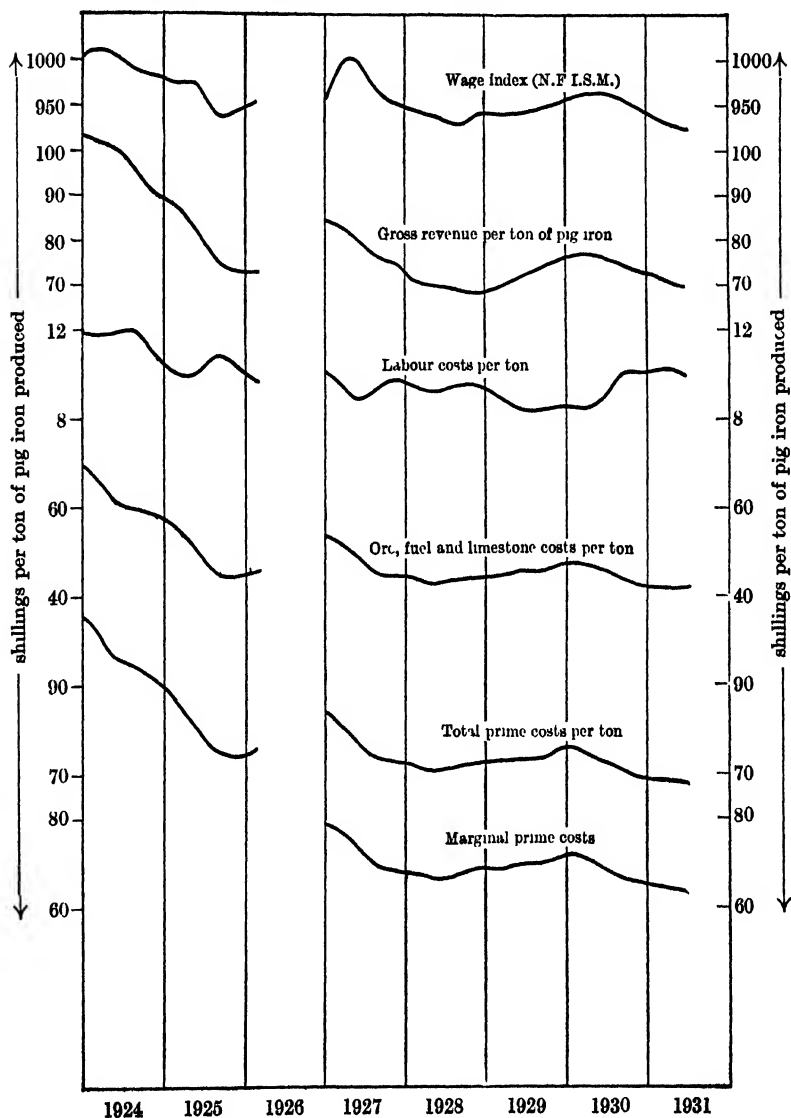
$$P - p = W \frac{dz}{dx}$$

$\frac{dz}{dx}$ can be obtained by differentiating the equation of Section II with respect to x , so the marginal prime cost is compared with the selling price. There is only a general similarity between the curves, a result which is not surprising. The average cost in some cases exceeds the price, particularly in 1928. If the possibility that the errors of the figures are sufficient to account for the whole difference is left out of consideration, there are two good reasons for this divergence: (a) the vertical organization of the industry makes it possible to spread costs over the whole process, from iron ore to steel plates; and so the ordinary machinery of price determination is not in operation, and (b) the manufacturers kept prices as low as possible in 1928 in order to keep foreign pig iron out of the market; imports fell from 579,300 tons in 1927 to 93,700 in 1928, and 122,000 in 1929.

This concludes the Section, and the essay. It may fairly be

objected that the cumulative effect of errors in interpolation, classification, etc. will have vitiated the final cost figures, in so far as they

DIAGRAM II.—Prices and Costs of Production of Pig Iron.



deal with absolute values : they should rather be regarded as indices. But the object of this essay is not so much to determine a set of rigid and definite results for one industry, as to show how a statistical

background can be built up, to help in the solution of the problems of industry.

Finally, I am very much indebted to Mr. C. G. Clark, of Cambridge, for continued encouragement and advice, and to Dr. J. Wishart, of Cambridge, for some valuable suggestions on the more mathematical side of the work.

PRICE AND COST STATISTICS FOR PIG IRON.

(All indices refer to the average of 1924 = 1,000.)

1. Quarterly index of the number of employed workers.
2. Quarterly index of the average daily production.
3. Index of labourers' wages.
4. N.F.I.S.M. earnings index, adjusted to refer to quarterly averages.
5. Gross revenue per ton of pig iron and ferro-alloys produced (in shillings).

Costs per ton of pig iron and ferro-alloys produced (in shillings).

6. Labour (includes wages and social insurance).
7. Fuel.
8. Iron ore.
9. Rail transport of coal, coke, iron ore, and limestone.
10. Total prime cost of production.

	1	2	3	4	5	6	7	8	9	10
1924 i	1049	1053	1009	1010	102.4	11.7	39.9	26.7	10.3	103.6
ii	1039	1031	1017	1010	100.9	11.8	34.3	26.1	10.4	96.6
iii	998	964	999	994	96.6	12.0	32.0	26.5	10.1	94.1
iv	915	951	974	985	90.8	11.0	30.7	26.9	10.1	92.0
1925 i	856	958	951	976	88.2	10.1	27.7	26.4	10.2	86.9
ii	802	909	949	977	83.5	10.0	23.5	25.7	10.1	80.8
iii	749	753	920	943	76.4	10.9	19.8	24.3	10.3	75.9
iv	762	800	922	941	73.4	10.4	18.9	24.4	10.3	74.5
1926 i	779	891	923	953	73.0	9.7	20.4	24.3	10.3	75.3
1927 i	795	935	946	977	83.5	9.8	25.9	24.9	10.1	82.1
ii	860	1126	970	1001	81.2	8.9	22.9	25.0	10.2	78.0
iii	826	996	957	971	76.7	9.4	19.1	24.5	10.3	73.4
iv	818	941	936	954	74.9	9.7	19.3	24.1	10.4	73.3
1928 i	798	936	930	946	70.7	9.4	19.3	23.1	10.2	71.7
ii	795	939	924	939	70.3	9.3	18.6	22.8	10.1	70.3
iii	740	848	926	929	69.1	9.5	18.9	23.6	10.4	71.9
iv	758	885	926	940	68.4	9.4	19.6	23.6	10.4	72.5
1929 i	772	930	928	943	69.2	9.1	19.8	23.6	10.3	72.5
ii	820	1057	927	942	71.4	8.5	20.5	23.9	10.5	73.3
iii	831	1097	931	946	73.3	8.4	20.7	23.7	10.6	73.2
iv	824	1067	937	953	75.4	8.6	21.6	24.4	10.6	75.3
1930 i	806	1063	948	964	75.8	8.5	22.1	24.1	10.5	75.3
ii	752	987	950	966	76.2	8.6	21.1	23.7	10.1	73.1
iii	643	721	944	959	74.5	10.0	19.8	22.6	10.2	71.3
iv	574	624	933	949	73.2	10.0	19.9	21.2	10.4	69.5
1931 i	525	563	920	935	71.7	10.2	19.9	20.8	10.3	68.6
ii	507	545	913	928	70.1	10.1	19.7	20.8	10.2	68.2

THE NATIONAL INCOME AND THE NET OUTPUT OF INDUSTRY.

By COLIN G. CLARK, M.A.

THE measurement of the national income, both in the determination of the absolute total and in the still more important matter of the measurement of the changes from year to year, is a subject which has as yet engaged the attention of very few investigators in this country, and one on which a wide measure of disagreement is possible. The purpose of this note is to discuss certain differences between my own recent estimate (*The National Income, 1924-31*, Macmillan) and those of other investigators.

Bowley and Stamp's estimate for 1924 of the net or social income of this country was £3,803 m. My own estimate, prepared by a similar method from statistics of Income Tax assessments and from estimates of the total paid in wages, etc., was £3,586 m. The main difference was in the total of wages, which they estimated at £1,600 m. and which I estimated at £1,413 m.

I have not differed, except by a very small amount, from Sir Josiah Stamp in his interpretation of the income tax statistics for 1924. Apart from the difference in the estimate of wages mentioned above, which I discuss fully elsewhere (*The National Income, 1924-31*, pp. 58-61), there is also a smaller difference between our estimates for the totals of "intermediate" incomes. This matter will be referred to again below.

For the years subsequent to 1924, my estimates show a considerable rise up to 1929, in which year I estimated the total money national income at 11·4 per cent. above the 1924 level. This was followed by a fall, and for 1931 I estimated £3,499 m., or 2·4 per cent. below 1924. *The Economist* (29th October, 1932) suggested that the 1931 figure should show a greater fall from the 1924 level, while Dr. W. H. Coates (*Manchester Statistical Society Proceedings*, 15th December, 1931) estimated a fall of £371 m. between 1924 and 1931. His totals refer to gross income and not to net social income, but there has been no considerable change over this period in the deductions which have to be made.

The Economist (loc. cit.) suggests that I have over-estimated the total paid in wages for 1931. The writer does not disagree with my estimate of the number of wage-earners, which is based on social insurance statistics, but suggests that the London and Cambridge Economic Service index-number of wage-rates which I use must be unrepresentative, and he demands that the Ministry of Labour should compile an index-number of wage-rates which "even if not absolutely complete, would be better than the best efforts of private enterprisers."

This has now been done (*Ministry of Labour Gazette*, March 1933, and *Bank of England Statistical Summary* for same month). But the result is a remarkable confirmation throughout of Dr. Bowley's previous index-number. For the average over 1931, Dr. Bowley's figure transferred to the average of 1924 as base, is 97·9, and the Ministry of Labour's figure is 97·6.

The difference between Dr. Coates' estimate, showing a fall of £371 m. between 1924 and 1931, and mine, showing a fall of only £87 m., if we neglect certain minutiae, can be analysed into three elements. The first, corresponding to a difference of £102 m., represents only a difference of definition. Changes in the valuation of stock-in-trade may have a big effect on the money national income at certain periods, and may give rise to an incomparability between Census of Production figures on the one hand, and Income Tax assessments and other profit statistics on the other hand (cf. the discussion reported in the *Journal of the Royal Statistical Society*, Part II, 1929). In the light of this discussion, I have based my work on the definition that when the physical quantity of stocks has remained unchanged, but their price has fallen, this is not to be regarded as a deduction from income. After allowing for this difference, Dr. Coates' estimates of 1931 profits are still considerably lower than mine. Finally, he estimates that the total paid in wages fell by £190 m. between 1924 and 1931, my estimate showing a fall of only £37 m. Dr. Coates does not give any information as to the methods by which his estimate of wages is compiled.

Bearing in mind the different treatment of the figures of stocks, it is possible to check my estimates of the totals of profits and interest against the broader of Sir Josiah Stamp's* two index-numbers of profits, which he describes as indicating the whole return, apart from wages and rents, upon businesses of all kinds (*J.R.S.S.*, 1932, pp. 670-71). In the following table I have re-expressed my own estimates (Table XXV in my book) after deducting the corrections which I had introduced for stock valuations (Table XXIV), in order to put my figures on a comparable basis with Sir Josiah Stamp's.

General Profit Index-Numbers, 1924-31.

	1924.	1926.	1927.	1928.	1929.	1930.	1931.
Stamp	100	98·3	106·5	106·2	109·9	100·9	90
Clark	100	99·4	104·0	105·9	111·8	104·2	84·3
Coates	100	—	—	—	—	—	75·5

* Sir Josiah Stamp has now (*The Times*, 9 August, 1933) amended the last three data so as to read: 1929, 106·8; 1930, 94·4; 1931, 84·0.

Considering the very different methods by which the first two estimates were prepared, and that they were prepared quite independently, the agreement is quite satisfactory.

The whole of my work on this national income has been vehemently attacked by Dr. Snow. His first criticism is that my estimate for the number of employers and independent workers in 1928 is too low by some 370,000, and my estimate of the number of salary earners too high by the same amount. But we must maintain a due idea of proportion. Even if my figures are in error to this whole extent, the estimates concerned being those relating to incomes outside the scope of income tax, and as the average incomes of the two classes concerned are £96 and £100 per annum respectively, the total estimate of the national income can only be altered to the extent of just over £1 m.

If, for the sake of argument, we also accept for the moment Dr. Snow's further contention that the average income of the whole of the former class is not £96 but £120, it still only affects the total national income by £16 m., or 0.4 per cent.

Dr. Snow disagrees with my estimate, based on extrapolation, which shows a considerable fall in the number of employers and independent workers between 1921 and 1928. I was aware that the figures used as a basis for extrapolation are incomplete, although there may be differing opinions about their degree of reliability. But this fall which I have estimated in their numbers is supported by other evidence, particularly a comparison between population and Health Insurance statistics. Almost the whole of the fall which I have estimated is among males, at the rate of 37,000 per annum over the period 1921-8. The average rate of increase of the male population aged 16-70 over this period was 139,000 per annum. It is difficult to get comparable Health Insurance figures over the whole period 1921-8, owing to the change in the value of money bringing additional numbers below the £250 limit, the exclusion of a number of men from Health Insurance owing to unemployment, and the break in the figures in 1928 due to the change in the upper age limit. But if we take 1922 as about the period when incomes and unemployment settled down to their general post-war level, we find that between the end of 1922 and the end of 1927 the average annual rate of increase of the number of insured males was 175,000 per annum, or 36,000 per annum greater than the increase of population. It is clearly improbable that there was any considerable change in the small number of unoccupied adult males, and although there were some changes in the administration of Health Insurance over this period, I think the figures point to the conclusion that there was a considerable

decline in the number of "independents" and small masters over this period. I think I am right in saying that the generous extensions of social insurance benefits which were made in 1925 had the effect of definitely attracting numbers away from independent work or partnership into paid employment. Not being able to secure access to the Census data, however, it is only by such means as this that one can hope to make any estimate at all of the changes in numbers of this class.

Next arises a matter already referred to, namely, the estimation of the average income of the small shopkeepers, hawkers, independent workers, etc. not assessed to Income Tax. For this purpose, requiring as we do to take account of the changing levels of the Income Tax exemption limit, we need some knowledge of the frequency distribution of incomes within this range. Dr. Snow sees fit to make fun of the frequency distribution which I use and says that the probable error must be very large. But I think he must have made some miscalculation. In the averages which I obtain the error cannot be greater than some 5%.

The only possible source from which we can hope at the present time to obtain this information is from social surveys, such as the New Survey of London Life and Labour and the Social Survey of Merseyside, which are now both approaching completion. I am sorry that on this matter figures are as yet only available from one of the two Surveys, and I hope the London figures will be available shortly. Those acquainted with these Surveys (I have served on the staff of both of them myself) will know the trouble taken to ensure that the sample is truly random. In these data the phrase "net income" means, of course, the proceeds of the business after deducting cost of materials and rent attributable to the shop or workshop.

The sample which I have used has the admitted defect of only being representative of one area. But (let there be no mistake about this) there is no alternative approach to this problem. Lacking such information, Bowley and Stamp had to use an estimate, relating to some 600,000 incomes, based on pure guesswork (cf. page 26 of their book). An estimate based on scanty data surely cannot be worse than an estimate based on no data.

Dr. Snow states that the average income of this class is £120 (as against my estimate of £96), his grounds being "knowledge of the frequency distribution of incomes in general." I do not know to what sources he is referring. Apart from certain highly speculative estimates, obtained by drawing Pareto curves, our only present information on the frequency distribution of small incomes is the information on the numbers of salary earners at different levels collected by Bowley and Stamp for 1924, information which I have

also made use of. In this the average of all incomes below £159 works out at £100. In their very rough estimate described above for small employers and independent workers (excluding farmers), Bowley and Stamp estimate £98 for the average of all incomes below £150.

I do not attach very great importance to my estimate showing a fall in the numbers of employers and independent workers between 1921 and 1928. I believe the trend has changed since 1928. I should probably be ready to agree with Dr. Snow's estimate of 1,600,000 for 1928, if he would give the methods by which it is calculated. But I certainly will not agree with his complementary contention, that I have over-estimated the number of salary earners. My estimate of an increase in the number of assessable salary earners from 1,715,000 in 1921 to 2,420,000 in 1928, or at a rate of 100,000 per annum, he describes as "so surprising that it should surely have arrested attention." Over the five years 1925 to 1930 (the series is broken at the beginning and end of this period by administrative changes) the numbers liable to income-tax increased by 500,000. Of this total, increased assessments of wage earners represented £26 m., corresponding to not more than 150,000 persons.

In actual fact my estimate of a big increase in the number of salary earners has just been supported in a striking manner, or, if anything, shown to be too low, by a new piece of evidence. The Emergency Budget of 1931 lowered the exemption limit for earned incomes from £162 to £125, and the last report of the Board of Inland Revenue gives the number of taxpayers under the new law at 8,400,000. Of these, I understand that 3,000,000 represent wage-earners. This means that in 1931 there were 5,400,000 non-wage-earners with incomes over £125 (excluding married women). The number of salary earners with incomes over £125 I estimated to represent 68 per cent. of the total of salary earners in 1921, 72 per cent. in 1924 and 77 per cent. in 1928. For entrepreneurs I estimate the current figure at 69 per cent. Whichever figure we take, it is clear that the total number of non-wage-earners in receipt of incomes in 1931 was at least 7,000,000. The total in 1921 as estimated by Bowley and Stamp was only some 5,750,000,* and it

* Salary earners, entrepreneurs, and unoccupied income-recipients, together with shop-assistants, who were reckoned as wage-earners by Bowley and Stamp, but who are included in the statistics of salary earners by the Inland Revenue.

I think the income of shop assistants, totalling perhaps as much as £100 m. in 1924, may account for a considerable part of the puzzling discrepancy between Bowley and Stamp's estimates and mine for that year. This total would apparently have been reckoned by them as wages and by me as salaries. Their total estimate of the national income for 1924 would appear to contain a certain amount of duplication; at the same time my estimates of the changes in the proportion of the national income taken by wages will be vitiated.

With the majority of the criticisms recently made by Prof. Bowley (*Economica*, May 1933) I am in agreement.

is fairly clear that the main increase has been in salary earners, with probably a smaller increase in the number of unoccupied income-recipients. My estimate of an increase of less than a million in the number of salary earners between 1921 and 1928 perhaps even errs in being too low.

Another respect in which my results have been very strongly attacked, both by Dr. Snow and by others, is in my estimates of the value of industrial production for the years since 1924. I was writing before the results of the 1930 Census of Production were available, and was setting out to make estimates of the gross and net value of industrial output for the years up to 1931. The only information available for years other than Census years consists of (i) index-numbers of production, showing the physical quantity of output of a number of intermediate commodities, but of comparatively few finished goods, (ii) Ministry of Labour statistics of the numbers employed in different industries, (iii) price indexes relating to exported manufactures.

These index-numbers of the prices of exported manufactures are, of course, a *pis aller*, although by re-weighting them, as I have done, in accordance with the relative importance of different commodities in total output instead of their relative importance in export, the validity of the index figures is improved. Their use is necessary because there is simply no other information available on the prices of finished manufactured goods, and it is impossible for a private investigator to collect the information from original sources. In this country neither our official nor our various private index-numbers of wholesale prices give any information on the prices of finished manufactures. Of course it is not easy to collect statistics of these prices, but a task which has been proved possible in the official index-numbers of Germany, U.S.A., Sweden and Canada should not be beyond the British Board of Trade.

Use of this already inadequate material is made still more difficult by the fact that the Board of Trade and the Ministry of Labour use an almost completely different system of industrial classification.

My method of estimating is to obtain for each year a figure for the total value of the final product of industry, and to deduct from this, in order to estimate the net output, the cost of primary materials, transport services, etc. In obtaining the figure for the final product of industry, certain constituent items such as the value of buildings can be estimated directly, and the remainder is estimated by a sort of weighted index-number. Taking the values of the output of various classes of finished goods in the Census year as bases, three multipliers are applied. The first represents the change in employment and the second the change in prices

relevant to each class of commodities, while the third is a flat-rate multiplier applied to all classes to represent the general change in the quantity of output per person employed. This last is calculated from such figures of the quantity of production in different industries as are available.

Such a method, assuming as it does a uniform rate of increase in output per head in the different industries, cannot be used to give results for individual industries, but should be valid for estimating the total net output of industry. The proof of the pudding must be in the eating. My calculation was made before the results of the 1930 Census were available, and it can be checked against the results subsequently published.

From published data from the 1930 Census of Production, covering some 90% of industry, the whole net output of industry in Gt. Britain in 1930 may be reckoned at some £1,597 m. (cf. *Economic Journal*, 1933, p. 216).

An alternative method of calculation, which avoids the difficulties of outstanding returns and small firms, is to take the Ministry of Labour employment figures, which are comprehensive, and to multiply these by the net output *per head* returned in the Census of Production (except for Public Utility trades, where the Ministry of Labour figures are incomplete, and the Census totals must be used as before). This gives an almost identical result.

My estimate comes within £56 m., or $3\frac{1}{2}$ per cent. of the correct figure. This is a very satisfactory agreement when we consider that it represents an estimate of the difference between two unknown quantities and also when we remember the rapidly fluctuating conditions of 1930. Imports of raw materials, for instance, were £562 m. in 1929, £441 m. in 1930, and £336 m. in 1931. For convenience I assumed that these materials were used by industry without lag in the same year as they were imported. If I had lagged my figures a month or two I should have got even closer agreement.

Accurate knowledge of conditions as they were three or five years ago is no compensation for a lack of information about present conditions, and in fact is often of less value than the roughest estimates which can be kept fully up to date. This will always be the *raison d'être* of such estimation as I have described above, in anticipation of the results of the Census of Production, subject, of course, to the proviso that we must be constantly checking and revising our methods and results as fuller data become available.

I began to work at this problem over three years ago as part of my duties on the staff of the Economic Advisory Council. Some of my work was later (not at my suggestion) submitted to the MacMillan Committee, and I was asked to give evidence before

them. The first table which I prepared went on the assumption that the net output and gross output of certain industries moved in proportion. This table has been criticized by Dr. Snow on several occasions—quite rightly. All that can be said in its defence is that it was one of the first attempts made by anybody to secure a calculation on these lines, and that it only refers to the period up to 1929, during which period relative price-changes were not very violent. I hope Dr. Snow will think better of me when I say that I myself tried to prevent its being published in the MacMillan Report, but was unable to do so. I have not used its results in any subsequent calculations.

I think it is justifiable to hark back to 1930 like this, because an ounce of information available at the time is worth a pound available later, and it would have been very little use to tell the MacMillan Committee that the results of a census of industrial production would be available in two and a half years' time. Although I may have been wrong in a number of details, I think I was right in emphasizing, actually at the time, the general conclusion that the value of net output per person employed in industry was about the same in 1930 as in 1921, a result subsequently confirmed by the Census of Production. At that time I concluded that the money national income in 1929 had been much higher than in 1924. These views were at the time strongly opposed by the Board of Trade and by other statisticians, who held that the national income in 1929 was very doubtfully in excess of 1924, and in 1930 was very much lower. Although my views, as a junior civil servant, were then mainly disregarded, I think it is only fair that I should now be able to claim the barren privilege of saying "I told you so"!

[*Editorial Note.*—Mr. Clark's article is a reply to the review of his book *The National Income* published in Part I of the *Journal*. The review criticized the statistical basis of the book, and there is nothing in Mr. Clark's article to change our view that his methods are so faulty that his results must be omitted in any serious discussions on the question of the national income.

We pointed out a serious error in one of the early estimates which influenced a number of other calculations in the book. Mr. Clark, by a most rash piece of extrapolation, reached the figure of 1,235,000 as the number of male "employers and independent workers" in Great Britain in 1928, the Census figure of 1921 being 1,493,000, made up of 1,312,400 in England and Wales and 180,700 in Scotland. As the actual Census figure for 1931 for England and Wales can now be quoted we think it should at once be put on record in order to avoid further controversy. It was 1,492,602,

showing an *increase* of 14 per cent. in the ten years in England and Wales compared with the *decrease* of 17 per cent. in eight years in Great Britain claimed by Mr. Clark. As Mr. Clark believes "The trend has changed since 1928" we refrain from interpolating the Census results to obtain a figure for 1928, but we should be very surprised indeed if, in fact, the number of "employers and independent workers" did decline from 1921 to 1928 and then subsequently rise again to the level indicated by these figures.

A further fallacy in Mr. Clark's statistical investigations should be brought to the attention of economists. In an article in the *Economic Journal* in June last he found a correlation coefficient of .86 between the Sauerbeck Index-Number and Great Britain's income from overseas investments over the period 1922-31. On the strength of this he extrapolated for the overseas investment income for 1932 and reached a figure considerably higher than that published by the Board of Trade in February last, and concluded: "I do not think the Board of Trade have given adequate grounds for their estimate of a further heavy fall between 1931 and 1932." A high correlation coefficient is a comforting thing, but it gives no sound ground for accepting an extrapolated figure rather than direct evidence relating to the year in question, when that year was so vastly different in many respects from the previous decade. In case economists are inclined to place credence on the importance of the correlation coefficient in calculating national income from the Sauerbeck Index-Number we will enlarge on this point. The correlation coefficient over the nine years 1923-31 worked out in a similar manner to that used by Mr. Clark is even higher than he obtained for the ten-year period, namely, .89. Supposing nobody had been interested in obtaining ten years ago by direct investigation the magnitude of the overseas investment income in 1922, but now required to calculate it, he might be led to employ such a formula as that used by Mr. Clark for the purpose. By extrapolation for the year previous to the period on which the correlation was based instead of the year following he would have reached a figure for 1922 of £204 million. In actual fact, the figure for 1922 was obtained years ago by direct investigation and it was found to be £175 million, a figure which has never been questioned during the past decade. The figure calculated by the coefficient of correlation would have been in error, accordingly, by about £30 million. Mr. Clark's extrapolation for 1932 may be just as much in error as the similar calculation made for 1922, and the use of a correlation coefficient affords no justification whatever for criticizing the Board of Trade estimate. E. C. S.]

CENSUS OF PALESTINE, 1931.

By A. ZAIMAN.

THE present British Occupation of Palestine began in 1917, and until 1922 the Government were content to rely upon estimates of population obtained mainly through District Administrators. In 1922 an enumeration was made under a definite system, and merits the title of First Census. Its scope, however, was much more limited than that taken on the 18th of November, 1931. This Second Census, with its carefully compiled data, presents for the first time a real conspectus of the population of Palestine, combined with an examination of the various aspects of the life and occupation of the inhabitants. No student of Palestinian affairs, or for that matter of population problems in general, can afford to neglect a study of the reports.

The work was carried out under the direction of Major E. Mills, and his masterly reports display erudition with an excellent grasp of statistical presentation. The confidence he shows in the handling of the material is a great compliment to those to whom he acknowledges indebtedness. He is certainly to be forgiven if some of the inferences he draws appear facile; for he has endeavoured to place at disposal all the information available and to indicate the extent to which important deductions can be drawn.

Volume I contains the General Census Report. It opens with an introduction describing the administrative procedure and methods of tabulation. The procedure is apparently modelled on that followed in India, but as it is little different from that of Egypt it is rather surprising that Major Mills did not approach his neighbours, particularly in the matter of borrowing the use of their machines for tabulation purposes. Chapters I and II deal with the distribution and movement of population; specially interesting sections are those concerned with density and rates of increase. The total population is given as 1,035,821, having increased by 36·8 per cent. since 1922; for Jews alone the increase was 108·4 per cent. The author is apparently unable to reconcile this remarkable increase with births, deaths and migration figures, and no doubt these other statistics are open to criticism; it is to be hoped that the difficulties of securing proper registration can be overcome before future censuses. Chapter III deals with birthplace, permanent place of residence, citizenship, and the topic of "nationality" within citizenship which is of peculiar interest in Palestine. It is noteworthy that the Jewish community is regarded as a "nationality," it being remembered that the number of Jews composing the

legal Jewish community is smaller than the number of persons in Palestine proclaiming themselves to be Jews. The chapter (No. IV) on Religion provides, amongst other things, brief accounts of the Druzes, the Samaritans and the different Christian Churches. In 1931, the Moslems, Jews and Christians represented 73·34, 16·86, and 8·82 per cent. of the total population respectively, as compared with corresponding percentages of 78·04, 11·07, 9·64 in 1922. In Chapter V the author devotes considerable attention to the subject of age and attempts to render the figures intelligible by means of smoothing out errors. He makes the interesting suggestion that "in vital statistics concerned with age Palestine would do well to compile data in two systems; first, that which suits its own characters, namely, a grouping such as 0- , 1- , 2- , 3-8, 8-13, 13-18, 18-23, 23-33, 33-43, etc., and, secondly, that which conforms to international practice, namely, a system of grouping such as 0, 1, 2-5, 5-10, 10-15, 15-20 or 15-25, 20-30 or 25-35, etc." The recorded distribution of age is, of course, affected by the influx of adult immigrants. Sex is discussed in Chapter VI. Conjugal condition is examined in Chapter VII, and separate summaries are given relating to Moslems, Jews and Christians. Marriage among Moslem females is practically universal and there are 1,083 Moslem wives to every 1,000 Moslem husbands: child marriage is not a serious problem. Among the Jews there is a strong disposition towards the married estate and the sexes are well balanced both by numbers and age; although there is nothing in Jewish religious law in Palestine forbidding plural marriages, the Jews of the Oriental communities have the tradition of a succession, rather than of a plurality, of wives. Divorce both by Moslem and Jewish husbands is easy to obtain. The structure of the Christian community is distorted by the presence of unmarried young men in His Majesty's Forces; the proportion of divorced persons is small compared with those of the other communities. Education and Language are dealt with in Chapters VIII and IX, and Infirmities in Chapter X. The chapter (No. XI) on occupations and organized industry is somewhat less satisfying, primarily owing to the difficulty of securing reliable information, and partly owing to the lack of methods of mechanical tabulation. The main conclusion is that 54 per cent. of the settled population are supported by agricultural occupations, of which the most important is ordinary cultivation, supporting 45 per cent. of the people; industry generally supports about 14 per cent. and transport over 5 per cent.; about 10 per cent. are engaged in trade, 3 per cent. in the professions or liberal arts, and 2·5 per cent. in public service; and rather less than 2·5 per cent. are of independent means, and the remainder are in miscellaneous and undefined occupa-

tions. Chapter XII gives a short account of the nomadic population, chiefly in the Beersheba district.

Volume I is illustrated with diagrams which give graphic emphasis to the records. At the close of each chapter are some excellent subsidiary tables (it would facilitate reference if the numbers of these were included in the Contents). There is also an Index, which is, however, more of an analysis of the report than an index for reference. A minor point of criticism is the multitude of footnotes to the text, some illuminating but others rather tedious.

Volume II contains the Principal Tables. They are excellent in arrangement and display. The only criticism that might be made is that for a population of the size of that of Palestine the classifications are too numerous, since they involve the insertion of many blanks and numbers less than ten.

The Report and the Tables are very well printed. In the whole 345 pages of Volume I only two or three insignificant misprints have been noticed.

MIGRATION AND DEPRESSION.

By E. P. NEALE.

DR. SNOW, in commenting on the interesting paper of Messrs. Leak and Priday read before the Society on the 17th January, stated that over a considerable part of the first half of last century the power making for emigration from Britain was a repelling force and that over the second half of the century it had been an attractive force from the other side, but that this attractive force from the other side had apparently now ceased: this contention being no doubt partly based on Table X in Messrs. Leak and Priday's Paper, which shows that since the fourth quarter of 1930 the usual outward movement of population from Britain has been reversed.

The prevalent view (to which it would almost seem Dr. Snow subscribes) that conditions in the country of destination have, since the development of communications, etc., in the middle of last century, been more important than conditions in the country of departure was challenged by me in the December 1932 issue of *The International Labour Review* on the basis of a comprehensive review of the migration figures of the past, the details of which need not be reproduced here.

The conclusion was there reached that such a form of statement has arisen from the tendency natural in the old lands to regard migration as essentially a flow of population from old countries to new, and that a more universally correct statement of the position is in the form that conditions in new undeveloped countries exercise a more powerful influence on migration streams than do conditions in older and more highly developed lands.

When depression prevails both in new lands and in old, especially in times of secular falls of prices (as at present), the push from new lands is likely to be more potent than the resistance from old lands, for a number of reasons:—

(1) The products of new lands are usually to a very large extent easily gradable foodstuffs and raw materials, which experience has shown to be subject to much greater price fluctuations than the manufactured articles which bulk largely amongst the products of older lands; for this reason as well as for reason (2) below the economic cycle might be expected to swing wider, and both prosperity and depression to be more pronounced in new than in old lands. Against this conclusion must, however, in fairness be placed the considerations (which by no means completely outweigh the major point): (a) that the nature of farm production is such that its volume is less rapidly responsive to price swings than is the volume of manu-

facturing production; and (b) that hired labour is relatively less important in farm occupations, so that in new lands unemployment is less likely to increase rapidly in times of depression than it is in manufacturing countries.

(2) New countries are usually debtor countries; and the real burden of their indebtedness increases as prices fall. At the same time the real income of older creditor countries is increased.

(3) In new countries the proportion of the total population that is engaged in capital works aiming at the development of the country will be greater than in older lands. Few countries have yet learned "long-range planning" of public works, i.e. a policy of saving up capital works in times of prosperity to be prosecuted with exceptional vigour in times of depression. Consequently a curtailment of public works activity in times of depression in new lands has a more adverse effect on the employment situation in such new lands than in older lands.

(4) In new countries businesses have not, generally speaking, accumulated reserves to the extent characteristic of businesses in older lands; it may therefore be expected that enterprises will succumb earlier and in greater numbers during a recession than in older lands, and that in consequence a larger proportion of people will be thrown out of employment in new lands soon after the onset of a period of depression.

(5) A given number of migrants necessarily constitutes but an infinitesimal percentage of the total population of the densely populated lands of the Old World whence have come the great historical streams of migrants. The influence of a few more or a few less of population on the labour situation and other conditions in those older countries can have a relatively negligible effect on the whole. In the case of thinly-peopled new countries such as New Zealand, the presence of an extra 50,000 people would have but a negligible effect, relatively speaking, on labour conditions in Britain, but would have a marked effect on the New Zealand labour situation; this figure being approximately equal to the largest number of registered unemployed ever recorded in New Zealand.

Economic conditions may be described as "dynamic" in new countries, as compared with the relatively "static" conditions prevailing in the older countries whence are recruited the new elements in the population of young and progressive lands.

These differences between new and old lands are gradually becoming less marked as manufactures develop in the new lands and as development of means of transport and other capital equipment proceeds; and this accounts for some falling-off in the strength of the "pull" from new lands in times of prosperity. But these

differences are still potent factors in the migration field and account for such phenomena as :—

(1) The already adverted to fact of a net migration gain for Britain each year since 1930;

(2) The emergence of algebraically negative net immigration figures for New Zealand in 1931 and 1932 and for Australia in 1930, 1931, and 1932. (See *Quarterly Bulletin of Australian Statistics*, March, 1933, page 4; *New Zealand Census & Statistics Office Annual Report on Migration*, 1932, page 1.)

The reason for the earlier emergence of an outward net migration in the case of Australia than of New Zealand is mainly to be found in the greater dependence of Australia than New Zealand on wool and wheat, which both slumped more than the other primary products that rank amongst New Zealand's exports; also the earlier closing of the London loan market to Australia than to New Zealand.

If this outlook on migration be adopted, then a good many of the points that seemed to be puzzling Dr. Snow will be cleared up.

REPORT OF THE COUNCIL.

For the FINANCIAL YEAR ended December 31, 1932, and for the SESSIONAL YEAR ending June 20, 1933, presented at the NINETY-NINTH ANNUAL GENERAL MEETING of the ROYAL STATISTICAL SOCIETY, held in the Hall of the Royal Society of Arts, John Street, Adelphi, W.C.2, on June 20, 1933.

THE Council have the honour to submit their Ninety-ninth Annual Report.

The roll of Ordinary Fellows on December 31 last, as compared with the average of the previous ten years, was as follows :—

Particulars.	1932.	Average of the previous Ten Years.
Number of Fellows at end of previous year ...	1064	1028
Number lost by death, withdrawal, or default ...	78	53
New Fellows elected	45	65
Number of Fellows on December 31	1031	1040

Since December 31st last, 18 new Fellows have been elected or restored to the list, and the Society has lost 60 by death, resignation, or default, so that the number on the list, excluding 22 Honorary Fellows, on June 20, 1933, is now 989.

Since June, 1932, the Society has lost by death the under-mentioned Fellows :—

		Date of Election.
	*Coxon, William	1902
	Crane, Henry	1921
	Gardiner, Francis Charles, F.S.A.A.	1928
<i>d</i>	Garnsey, Sir Gilbert Francis, K.B.E., F.C.A.	1910
	Goodman, Arthur Frank	1916
	Hartwell, Alfred	1916
<i>d</i>	Kenworthy, Capt. Leslie A.	1926
<i>d</i>	Kitchin, Joseph	1913
<i>c d p</i>	Mallet, Sir Bernard, K.C.B.	1904
	*Page, Edward D.	1887
	*Reed, Thomas, F.C.A.	1889
	Robinson, Capt. James	1900
	Robinson, Charles Alan	1930
	*Stern, Sir Edward D., Bt.	1882
<i>c d p</i>	†Stevenson, T. H. C., C.B.E., M.D.	1908
	Turvey, Frederic James	1924
	Welford, C. W.	1922
<i>c d</i>	Whitelegge, Sir B. Arthur, K.C.B., M.D.	1892
	Witty, Featherstone	1923

Honorary Fellow.

d p March, Lucien, *elected* 1911.

c Has served on Council

d Donor to the Library.

p Contributed a Paper or Papers.

* Life Fellow.

† Guy Medallist.

During the past year there were nineteen deaths among the Fellows, and two names in the list are conspicuous in the records of the Society : those of Sir Bernard Mallet and Dr. T. H. C. Stevenson. Sir Bernard was elected to Fellowship in 1904; he served on the Council from 1905 to 1912 (as a Vice-President in the sessions 1907–8 and 1908–9) and again from 1913 to 1916, in which year he became President of the Society. During his term of office he delivered two addresses, “The Organisation of Registration in its bearing on Vital Statistics” in 1916, and “Vital Statistics as affected by the War” in 1917. He took part in all the Society’s activities, willingly giving his time to assist by serving on special Committees, and frequently contributing to the discussions at meetings and to the *Journal*. Dr. Stevenson, who joined the Society in 1908, was first elected to the Council in 1911, served as Honorary Secretary from 1915 to 1920 and was a Vice-President from 1924 to 1926. The Society was indebted to him for several very valuable papers on Vital Statistics which he read at their meetings. The most important of them was perhaps that on “The Fertility of Various Social Classes in England and Wales from the Middle of the Nineteenth Century to 1911,” read in 1920. For this paper and in recognition of his signal services to Vital Statistics, the Society awarded him in the same year the Guy Medal in gold. These two distinguished Fellows, whose loss is deeply mourned by their colleagues, worked together for the eleven years 1909–20, as Registrar-General and Superintendent of Vital Statistics respectively, at Somerset House, and they died within a few weeks of one another in the autumn of 1932. Biographical notices of both were published in Part I of the *Journal* for 1933.

Sir Arthur Whitelegge, whose Fellowship extended over more than forty years, had also served on the Council. He was a donor to the Library, as were Sir Gilbert Garnsey and Mr. Joseph Kitchin, whose regular presentation of his annual Trade Cycles Chart showing the curves of business and financial activity was greatly appreciated by those using the Library. The longest durations of Fellowship on the list are those of Sir Edward Stern and Mr. E. D. Page, which cover over fifty and forty-five years respectively.

The Society has also to deplore the loss by death of Monsieur Lucien March, formerly Chief and afterwards Honorary Director of the Statistique Générale de la France, sometime President of the Société de Statistique de Paris, and the author of many statistical books and papers ranging over a wide variety of subject-matter. He was elected to Honorary Fellowship of the Society

in 1911, and in 1912 he contributed to the *Journal Miscellanea* a paper on “Some Researches concerning the Factors of Mortality.”

Since June, 1932, the following new Fellows have been elected :—

Atty, J. M., A.L.A.A.	Hill, Horace Frank.
Bone, Albert Reginald, A.C.I.I.	Jay, Douglas Patrick Thomas.
Brady, Sydney Edward Joseph.	McKay, Alfred Tozer, M.Sc.
Burraston, Victor Harold, B.Com., F.C.R.A.	Meekins, R. W.
Cambridge, Edgar Walter John.	Metz, Stewart Sigmund.
Daubenton, François, M.D.	Morcher, John William.
Derrick, Victor Percival Augustine, F.I.A.	Mukerjee, Jamini Bhusan, M.I.H.
Duval, Leon Frederic.	Neyman, Jerzy.
Ethell, Arthur, F.I.S.A., A.C.P.A.	Povey, Henry William.
Fleury, Francis George.	Sen, Dines Charan.
Grennan, Richard Leslie.	Spaull, Alfred Henry.
Griffiths, Thomas William.	Stalker, John, O.B.E.
Hall, Herbert Cyril.	Stanley, George Arthur Grantham.
Halstead, Cyril Clement Leonard, A.C.A., F.F.I.	Sundaresan, S., M.A.
Harvey, Victor Herbert James.	Tippett, Leonard Henry Caleb.
Hayward, Charles Arthur.	Tommerup, E. C.
	Vedantaiengar, B., B.A.
	Watts, Reginald Edward.
	Whitaker, Ralph Raymond.

Representatives of Corporate Bodies :

Goss, John William,	<i>representing</i> the Calculating and Statistical Service.
Powell, Nancy,	<i>representing</i> the J. Walter Thompson Company.
Rushby, Betty Fairfax,	<i>representing</i> Greenly's, Limited.

During the Session 1932–33, 38 new Fellows were elected, and the total number of Ordinary Fellows is now 989.

Statements showing the receipts and expenditure during 1932 and the financial position at the end of that year will be found, as usual, in the appendices. It will be noticed that in contrast to the four preceding years, in each of which the income showed a substantial surplus over the expenditure, in 1932 there was a deficit on the year's working. Resignations were rather more numerous than usual and there was also a slight decrease in the number of subscriptions to the *Journal* received from foreign countries. This state of affairs is not unnatural in view of the general depression. The Council have taken steps to improve the position by effecting certain economies which will in no way detract from the efficiency of the Society's work. They hope, however, that every

effort will be made by Fellows to assist in bringing about an increase in the numbers of the Society in order that its work may be continuously developed and its usefulness extended.

The Ordinary Meetings have been held in each month of the Session, and the papers read before the Society were as follows :—

1932.

- I.—November 15th ... The RT. HON. LORD MESTON OF AGRA AND DUNOTAR, K.C.S.I., LL.D. Statistics in India (Presidential Address).
 II.—December 20th ... PEARSON, E. S., D.Sc. Statistical Method in the Control and Standardization of the Quality of Manufactured Products.

1933.

- III.—January 17th ... LEAK, H. and PRIDAY, T. Migration to and from the United Kingdom.
 IV.—February 21st ... HILL, A. BRADFORD, Ph.D., D.Sc. Some Aspects of the Mortality from Whooping-Cough.
 V. March 21st ... FENELON, K. G., M.A., Ph.D. British Railways since the War.
 VI. April 25th ... HAWTREY, R. G. Public Expenditure and Trade Depression.
 VII. May 16th ... JEVONS, H. STANLEY, M.A. Causes of Fluctuations of Industrial Activity and the Price-level.
 VIII. June 20th ... FLUX, A. W., C.B., M.A. The Measurement of Price Changes : Retrospect and Prospect.

The Study Group completed its fifth year with the close of the session 1932–33. Under the Chairmanship of Miss Iris Douglas nine meetings were held and the subjects and openers of the discussions were as follows :—

1932.

- Oct. 12th ... The Distributive Trades since 1920.—THE CHAIRMAN.
 Nov. 6th ... The Geneva Convention on Economic Statistics in relation to Foreign Trade.—H. C. CRAFT.
 Dec. 5th ... The Accurate Measurement of Price Changes.—A. P. L. GORDON.

1933.

- Jan. 10th ... Some Aspects of Statistical Measurement of Railway Efficiency.—T. CLIFTON.
 Feb. 14th ... Meat Supplies of the United Kingdom.—A. R. LESTER.
 Mar. 14th ... World Production of Food-stuffs.—H. V. KNIGHT.
 Apr. 11th ... Statistical Progress of the Motor Industry.—L. F. DUVAL.
 May 9th ... Ten Years of Industrial Psychology.—Dr. MAY SMITH.
 June 13th ... Review of the First Five Years of the Study Group.—R. F. GEORGE.

The December meeting was held in conjunction with the Institute of Actuaries Students' Society at Staple Inn Hall, with Mr. Palin Elderton, President of the Institute of Actuaries, in the Chair.

The Frances Wood Memorial Prize, offered for competition in 1932, was awarded by the Council to Mr. R. W. B. Clarke for an essay on "Production, Output per Head, Costs and Prices in the Iron and Steel Industry, 1924 to 1931," and he was accordingly presented with a cheque of the value of £30 at the meeting of the Society held on the 25th of April, 1933.

As announced in Part III of the current *Journal* (p. 531), the Council have authorized the formation of an "Industrial and Agricultural Research Section" of the Society, which will be concerned with the application of modern statistical methods to technical problems met with in industry and agriculture. It is proposed to hold four meetings in each session and to publish a Supplement to the *Journal* which will contain the papers read and the discussions thereon and will be entirely devoted to the study of this aspect of statistical science. Membership of the Section will be open to all Fellows of the Society and it is contemplated that there should also be a class of subscribers to the Supplement who would have the right of attending the meetings of the Section.

In last year's report the Council referred to the prospect of an invitation to the International Statistical Institute to meet in London in connection with the celebration of the Society's Centenary in the spring of 1934. Fellows will be glad to know that the invitation has now been given and accepted and that arrangements for the reception and entertainment of the guests and for the centenary meetings are in progress. The Honorary President of the Society, H.R.H. the Prince of Wales, has graciously indicated his willingness to preside at the Centenary Meeting, and the University of London, University College, has generously offered its hospitality for the reception ceremony and the subsequent meetings of the Institute.

In the year ended May 31st, 1933, 1,304 works were added to the Library, compared with 1,387 the year before. These figures exclude periodicals regularly received and a number of minor Parliamentary Papers. During the same period 1,713 volumes were borrowed by 794 Fellows, against 2,162 by 731 Fellows the year before.

The Fellows named below (nominated in accordance with By-law 14) are recommended for election as President, Council and Officers of the Society for the Session 1933–34 :—

President.

The Right Hon. the Lord Meston of Agra and Dunottar, K.C.S.I., LL.D.

Council.

Sir Percy Ashley, K.B.E., C.B.	Robert Holland-Martin, C.B.
W. A. Basham, O.B.E.	Leon Isserlis, D.Sc.
Sir W. H. Beveridge, K.C.B.	H. Stanley Jevons, B.Sc.
*J. Bonar, LL.D.	*J. Maynard Keynes, C.B.
*Prof. A. L. Bowley, Sc.D., F.B.A.	A. W. Waterlow King.
Henry Clay.	*H. Leak.
Clara E. Collet.	H. W. Macrosty, O.B.E.
Dorothy P. Etlinger.	*Sir A. Newsholme, K.C.B., M.D.
*R. A. Fisher, Sc.D., F.R.S.	E. C. Rhodes, D.Sc.
Prof. Major Greenwood, F.R.S.	E. C. Snow, D.Sc.
A. P. L. Gordon.	J. Calvert Spensley, O.B.E.
Sir W. H. Hamer, M.D., F.R.C.P.	J. W. Verdier, O.B.E.
R. G. Hawtrey.	Harold D. Vigor.
David Heron, D.Sc.	S. P. Vivian, C.B.
A. Bradford Hill, Ph.D., D.Sc.	John Wishart, D.Sc.

Those marked * are proposed as new Members of Council.

Honorary Treasurer.

Robert Holland-Martin, C.B.

Honorary Secretaries.

Prof. M. Greenwood, F.R.S.	H. W. Macrosty, O.B.E.
E. C. Snow, D.Sc.	

Honorary Foreign Secretary.

Prof. M. Greenwood, F.R.S.

The abstract of the Treasurer's account of receipts and payments and the balance sheet as on December 31, 1932, together with the report of the Auditors on the accounts for the year 1932 are appended.

Signed on behalf of the Council,

MESTON,

President.

M. GREENWOOD,	} <i>Hon. Secretaries.</i>
H. W. MACROSTY,	
E. C. SNOW.	

APPEN

A.—(i) RECEIPTS AND PAYMENTS ACCOUNT FOR

RECEIPTS.							
Year 1931.					Year 1932.		
£	s.	d.			£	s.	d.
			Annual subscriptions :—				
1,512	0	0	For current year (695)	... ..	1,459	10	0
102	18	0	Arrears (56)	... ..	117	12	0
52	10	0	In advance (21)	... ..	44	2	0
<hr/>					<hr/>		
1,667	8	0			1,621	4	0
			Dividends and interest (including in-				
451	11	9	come tax refunded)	... ..	459	16	4
947	12	3	Journal sales (including reprints)	... ..	823	11	6
8	5	0	Journal advertisements	... ..	5	12	6
4	14	6	Sales of other publications	... ..	2	0	2
60	0	0	Use of rooms	... ..	30	0	0
—			Special subscription	... ..	10	10	0
3	10	0	Study Group subscriptions	... ..	3	10	0
3	10	4	Miscellaneous	... ..	2	16	11
<hr/>					<hr/>		
3,146	11	10	Total of Ordinary Receipts	... ..	2,959	1	5
115	10	0	Life compositions	... ..	126	0	0
					<hr/>		
			Excess of payments over receipts	... ..	3,085	1	5
					133	7	5
<hr/>					<hr/>		
£3,262	1	10			£3,218	8	10
<hr/>					<hr/>		

DICES

THE YEAR ENDED 31st DECEMBER, 1932.

			PAYMENTS.					
Year 1931.						Year 1932.		
£	s.	d.				£	s.	d.
			Journal:—					
693	13	11	Printing and paper	..	..	809	5	2
55	2	6	Reviewing	...	...	96	2	6
23	14	0	Reporting	...	...	23	5	6
87	1	5	Distribution	...	...	108	17	1
43	16	4	Re-purchase of scarce parts	...	...	15	11	0
<hr/>						<hr/>		
903	8	2				1,053	1	3
			Meetings (including printing and post- age)			160	12	1
146	10	8	Library books			83	3	1
74	14	11	Library binding...			151	8	5
131	7	1	Salaries and wages			1,004	16	4
921	9	8	Rent			380	0	0
380	0	0	Land tax			2	7	6
2	15	5	Insurance			14	4	11
14	4	10	Fuel, light and water			98	12	1
84	12	1	House expenses			36	16	2
51	3	3	Repairs to premises			36	13	9
19	7	3	Furniture and equipment (including typewriter and new lamps in 1932)			25	17	9
7	17	8	Postage, carriage and telephone			27	7	4
61	16	4	Stationery and miscellaneous printing			115	14	3
106	9	7	Study Group expenses...			1	8	0
9	8	0	Agreement for premises (legal fees and stamp)...			—		
12	17	0	Miscellaneous			7	7	8
4	17	5				<hr/>		
2,932	19	4	Total of Ordinary Payments			3,199	10	7
			Centenary Fund circulars			10	13	3
			Refund to Frances Wood Memorial Fund (amount due from 1931, less advances in 1932)			8	5	0
329	2	6	Excess of Receipts over Payments			—		
<hr/>						<hr/>		
£3,262	1	10				£3,218	8	10
<hr/>						<hr/>		

APPEN

A.—(ii) BALANCE SHEET

LIABILITIES.							
Year 1931.				Year 1932.			
£	s.	d.		£	s.	d.	
52	10	0	Advance annual subscriptions ...	44	2	0	
69	4	0	Advance Journal subscriptions ...	104	15	9	
247	18	6	Sundry creditors	233	4	3	
<hr/>				<hr/>			
369	12	6		382	2	0	
1,514	2	0	Life composition fund	1,640	2	0	
			Balance in favour of the Society (ex- clusive of (1) Books in Library, (2) Journals and other publications in stock, and (3) Pictures, Furniture and Fixtures)... ..				
8,609	16	5		7,984	1	0	

£10,493 10 11

£10,006 5 0

BUILDING FUND (ESTAB

On 31st December, 1931, the Fund consisted of £664 5s. 11d. 3½ per cent. Con 1932 (£47 13s. 7d.) and also the refund of income tax on the 4 per cent. Consols £32 10s. 8d. 4 per cent. Consols, and the Fund now consists of £689 18s. 5d. value at 31st December, 1932 (at 99½ and 106½ respectively) being

FRANCES WOOD MEMORIAL FUND

On 31st December, 1931, the Fund consisted of £500 4 per cent. Preference During 1932, dividends of £11 were received, and the Fund was credited and postage. Thus at 31st December, 1932, the Fund consisted of £500 31st December 1932, at 36½, £182 10s.), and £113 4s. 10d. cash in hand.

REPORT OF

“We have examined the foregoing Receipts and Payments Account, Balance Memorial Fund with the Books and Vouchers of the Society and find them opinion, properly drawn up so as to exhibit a true and correct view of the Investments and Cash Balances.”

DICES

AT 31st DECEMBER 1932.

			ASSETS.				
Year 1931.					Year 1932.		
£	s.	d.			£	s.	d.
			Investments, at cost or under :—				
1,185	0	0	£2,236 11s. 3d. 2½% Consols (General Fund)		1,185	0	0
5,580	0	0	£10,527 12s. 3d. 2½% Consols (Guy Bequest)		5,580	0	0
1,299	0	0	£1,841 3½% Conversion Loan		1,299	0	0
504	0	0	£500 3½% War Loan		490	0	0
—			£1169 17s. 6d. 3% Local Loans Stock		800	0	0
386	0	0	£666 4% 2nd Pref. Stock, L. & N.E. Rly.		100	0	0
101	0	0	£266 5% Prefd. Ord. Stock, L. & N.E. Rly.		25	0	0
9,055	0	0	(Market value, £12,908)		9,479	0	0
			Cash :—				
				£ s. d.			
			On deposit	150 0 0			
			On current account	220 17 10			
			In hand	7 0 0			
1,311	5	3			377	17	10
84	0	0	Arrears of annual subscriptions recoverable (say 40)		84	0	0
43	5	8	Sundry debtors		65	7	2
£10,493	10	11			£10,006	5	0

LISHED 10TH JULY, 1873).

version Loan, and £597 13s. 9d. 4 per cent. Consols. The dividends received during (£7 14s. 7d.) were invested in £25 12s. 6d. 3½ per cent. Conversion Loan, and 3½ per cent. Conversion Loan, and £630 4s. 5d. 4 per cent. Consols, the total £1355.

(ESTABLISHED 13TH MAY, 1920).

Stock, London, Midland & Scottish Railway, and £93 3s. 6d. cash in hand. with £13 15s. income tax refunded and debited with £4 13s. 8d. for printing 4 per cent. Preference Stock, London, Midland & Scottish Railway (value at

THE AUDITORS.

Sheet, and Statements in regard to the Building Fund and the Frances Wood to be in accordance therewith. We report that the Balance Sheet is, in our state of the Society's affairs, as shown by the Books. We have verified the

(SIGNED) P. G. BROWN.
A. M. SOUTHALL.
J. W. VERDIER.

APPEN

B.—STATEMENT OF THE CONDITION OF THE SOCIETY

Year.	Constitution.				Fin					
	Number of Fellows at end of Year.		Changes during the Year.		Receipts.					
	Totals.	Life Fellows included therein.	Gains by Election, &c.	Losses by Death, &c.	Annual Subscriptions.	Compositions. ¹	Dividends, Interest, &c. ²	Journal Sales.	Other Items.	Totals.
1908	855	170	40	46	£ 1,339	£ 84	£ 351	£ 254	£ 143	£ 2,171
1909	825	167	52	82	1,307	84	354	273	42	2,060
1910	845	172	57	37	1,304	141	420	326	54	2,245
1911	867	174	62	40	1,415	126	341	308	65	2,255
1912	854	175	44	57	1,336	105	341	334	41	2,167
1913	846	174	53	61	1,331	84	341	294	58	2,108
1914	821	169	39	64	1,281	42	339	271	51	1,884
1915	772	163	12	61	1,243	63	319	268	32	1,925
1916	758	163	34	48	1,181	42	284	325	18	1,850
1917	757	161	40	41	1,186	53	276	311	130	1,956
1918	761	167	47	43	1,132	222	456	305	3	2,119
1919	796	172	91	56	1,297	273	276	603	10	2,459
1920	882	180	123	37	1,373	251	291	730	95	2,740
1921	946	186	112	48	1,481	231	603	662	39	3,015
1922	969	187	71	48	1,499	126	454	689	142	2,910
1923	996	195	66	39	1,476	242	506	739	114	3,075
1924	1,002	194	68	62	1,638	105	400	666	81	2,890
1925	1,030	195	79	51	1,611	189	399	807	43	3,049
1926	1,054	197	77	53	1,619	116	404	780	112	3,031
1927	1,074	199	62	42	1,665	84	376	792	84	3,001
1928	1,079	201	56	51	1,680	84	397	748	87	2,996
1929	1,076	202	61	64	1,804	137	400	866	124	3,331
1930	1,058	204	50	68	1,663	126	451	1,026	680 ³	3,946
1931	1,064	208	62	56	1,667	115	452	948	80	3,262
1932	1,031	210	46	79	1,621	126	460	824	54	3,085

¹ Carried to Life Composition Fund from 1921 onwards.² Including income tax refunded.³ Exclusive of the Building and Frances Wood Memorial Funds.

DICES

DURING THE LAST TWENTY-FIVE YEARS, 1908-1932.

ance.

Payments.							Market Values of Invest- ments at end of Year. ^a	Year.
Journal.	Meet- ings.	Library, Books and Binding.	Salaries and Wages.	Rent.	Other Items.	Totals.		
£	£	£	£	£	£	£	£	
535	72	93	602	380	458	2,140	11,920	1908
636	74	99	550	380	315	2,054	12,085	1909
808	90	74	582	380	727 ^a	2,661	11,210	1910
621	89	104	602	380	576	2,372	10,874	1911
725	85	81	620	380	283	2,174	10,599	1912
658	76	79	632	380	233	2,058	10,092	1913
793	82	88	615	380	361	2,319	9,528	1914
458	64	40	480	380	222	1,644	8,182	1915
516	50	36	492	380	181	1,655	7,702	1916
413	71	54	516	380	199	1,633	7,656	1917
651	91	33	534	380	211	1,900	8,282	1918
774	86	50	645	380	349	2,284	7,672	1919
913	89	99	904	380	454	2,839	6,848	1920
900	110	94	954	380	390	2,828	7,605	1921
983	98	103	1,006	380	755 ^b	3,325	8,605	1922
922	146	107	1,010	380	445	2,940	8,666	1923
947	127	138	1,022	380	357	2,971	8,962	1924
940	132	116	1,021	380	373	2,962	8,423	1925
1,144	131	98	991	380	366	3,110	8,122	1926
1,213	150	119	899	380	302	3,063	8,375	1927
835	136	104	793	380	517	2,765	8,343	1928
839	150	156	878	380	238	2,741	8,462	1929
841	151	120	864	380	408	2,764	9,636	1930
1,053	147	206	921	380	376	2,933	9,151	1931
903	161	235	1,005	380	384	3,218	12,908	1932

^a Includes £436 for re-decoration, etc., in 1910.^b Includes £395 for Catalogue printing in 1922.^c Includes £600 from sale of *Times* in 1930.

PROCEEDINGS OF THE NINETY-NINTH ANNUAL GENERAL MEETING OF
THE ROYAL STATISTICAL SOCIETY HELD IN THE HALL OF THE
ROYAL SOCIETY OF ARTS ON TUESDAY, JUNE 20TH, 1933.

The Chair was taken by the President, the Rt. Hon. LORD MESTON OF AGRA AND DUNOTTAR, K.C.S.I., LL.D., at 5 p.m.

The HONORARY SECRETARY read the circular convening the meeting.

The Report of the Council for the financial year 1932 and the Session 1932-33 was presented by the CHAIRMAN to the meeting and was taken as read. Moved by the CHAIRMAN, seconded by Dr. Irwin, and carried unanimously, that the Report be adopted, entered in the Minutes, and printed in the Journal.

Professor GREENWOOD, HONORARY FOREIGN SECRETARY, reminded Fellows of the coming Centenary of the Society in the spring of 1934, and reported the progress of the plans for its celebration and for the entertainment of the International Statistical Institute, which would take place during the week beginning April 16th, 1934. He was able to announce that the Honorary President, H.R.H. the Prince of Wales, hoped to preside at the Centenary Meeting, and that the University of London, University College, had generously offered its hospitality for the meetings of the Institute, the members of which, with the official delegates to the sessions, would be received by the Earl of Athlone, Chancellor of the University. The Manchester Statistical Society, whose own centenary would be celebrated this autumn, had also signified its desire to invite certain of the Fellows and their distinguished visitors to participate in a joint meeting under the auspices and with the assistance of the University of Manchester.

The HONORARY SECRETARY announced that certain names would be removed from the roll of the Society as those of defaulters in accordance with Bye-Law No. 9 :

The names in question were those of

H. B. B. Beldham, L. F. Cheyney, M. E. Day, L. Donavour-Hickie, Philip Gee, the Rt. Hon. Arthur Greenwood, S. R. Kabboor, J. M. Mackenzie, A. L. Macmillan, A. Rive, A. D. Smith, C. R. Stiles, L. Sundaram.

It was announced that as a result of the ballot taken during the meeting Mr. Herbert Cyril Hall had been elected a Fellow of the Society.

The ballot for the election of the Council and Officers for the ensuing Session was then taken, Mr. G. R. White and Mr. R. F. George being appointed as scrutineers.

Dr. Bonar proposed a vote of thanks to the President and Council of the Society, incidentally paying tribute to the zeal and devotion with which their work was performed.

Mr. Glenday seconded the proposal, which was carried unanimously.

The CHAIRMAN announced that the Council and Officers named on the ballot paper had all been elected.

The Meeting then adjourned for the Ordinary Meeting.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS.

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1.—*An Introduction to the Computation of Statistics*. By Shepherd Dawson. With forty-two diagrams. University of London Press, 1933. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. 192 pp. 10s. 6d. net.

Authors of statistical text-books have by now rung most of the changes that are possible in the titles of their works. That of the present book may be questioned on the score of grammatical correctness, unless indeed statistics is understood to be the plural of that singular word invented by Fisher for a special purpose, but it is evidently meant to convey to the reader that the author is concerned to present the results of theory in a form suited to numerical computation. The book is intended for the use of laboratory workers, students of psychology, physiology, biology, medicine and education, which is certainly comprehensive enough. In so far, however, as the examples are any guide to the main interests of the author, these lie, as is known, in the realms of psychology and educational science. There is no lack of material. Most of the coefficients and tests that have emanated in the past from the Galton Laboratory of the University of London find a place, while there is also a general undercurrent of thought suggesting that when the sample is small (we are told that this means below 30) separate methods, due to Fisher, must be used. It is scarcely fair to Fisher to suggest that his contributions to mathematical statistics form a patchwork designed only to fill in the awkward corners of established theory. Such a statement, if made directly, would be totally untrue. Rather

should it be said that the researches of the new Galton professor have led to an entire re-orientation in our minds of certain of the concepts of statistical science, and that in particular the presentation of the theory of what is loosely termed "probable error" must be wholly revised. In the circumstances it is not surprising that the work under review does little to clear the air on this subject of sampling theory. We feel that the author, while not a professional statistician, has nevertheless devoted a great deal of time to the study of statistics, yet in certain aspects at least he has not been able to present a fully authoritative treatise. The non-mathematical student has in any case a difficult row to hoe in getting up the subject. All the more reason, then, for the text-book writer to make no mistakes, and to avoid loose statements. Examples of these abound, and it will be impossible in a review of reasonable length to do more than illustrate with a number of the more important cases.

Apart from definite omissions, such as the method of analysis of variance and the important Poisson distribution, both widely applied by biological workers, to whom among others the book is addressed, perhaps the most important weakness is in the treatment of sampling theory. The probable error is correctly explained in relation to the theory of the normal curve, but the author goes on to say that there are probable errors of all sorts of statistical constants without referring to the fact that normality of distribution of these constants is the exception rather than the rule, and he chooses a most unfortunate illustration in the correlation coefficient, the treatment of which has to be qualified later. The plan is followed of leaving out difficult proofs and putting in from time to time easy ones. He might have attempted, however, a proof of the formula for the standard error of a mean, since in another connection he gives a proof, albeit a very odd one, for the standard deviation of the binomial series. When the standard deviation is reached its standard error is given without discussion of the approximate nature of a result which, incidentally, is marred by a misprint, and of the non-normality of the distribution. The statement with regard to the z -distribution on p. 112 is lacking in precision, while the standard error is given wrongly. In connection with goodness of fit the statement that when $\chi^2 = 0$ there is perfect agreement between the actual and theoretical frequencies, while in strictness true, is less important than a discussion of its distribution in random samples from some theoretical population, and the relation of this to the test employed. A strange statement is that the χ^2 test should be used only with frequencies, as it *may* not apply to *rates*. A further note (p. 124) on the effect on χ^2 of dividing the observed frequencies by 10 would seem to be without point. In discussing a "small sample" test for the correlation coefficient (p. 138) it is not stated that this depends on the knowledge of the frequency distribution of r when ρ is zero, while it is difficult to see why a more direct test by Fisher's Table VA is not mentioned. To add that because $t = r\sqrt{(n' - 2)}/\sqrt{(1 - r^2)}$ then the standard error is obviously $\sqrt{(1 - r^2)}/\sqrt{(n' - 2)}$ instead of the usual $(1 - r^2)/\sqrt{n'}$ is definitely wrong, and betrays a complete misunderstanding of the test employed. In a statement

on the same page that $1/\sqrt{(n' - 3)}$ is practically independent of the value of ρ the word "practically" would appear to be unnecessary. Some of the calculations of odds for the ratio of a difference to its standard error having an assigned magnitude are wrong, for the author should distinguish between cases where one or both "tails" of the distribution are required. A further point which may be questioned is that if biserial r be calculated then there is a formula which gives the true ρ in terms of the r from a single sample. The absurdity of this statement is manifest by a calculation purporting to show that ρ differs by only 0.001 from r , while the latter has in fact a standard error of 0.114. The description of the correlation ratio test by Woo's table is characterised by looseness of statement and by inaccuracies, while a more direct test is dismissed without description by a reference to Fisher's book.

The foregoing will suffice to show that the book will require careful re-editing before it can confidently be recommended to the student. In addition there are a great many misprints, which even invade the classified list of formulae at the end. The notation is in some places faulty, as when we are told on p. 177 that the mean is $\Sigma(x)/n$ whereas the standard deviation is $\sqrt{\{\Sigma(x^2)/n\}}$. On pp. 66, 93, 119, 134 and 151 the printer does not seem to have been able to make up his mind as to the proper fount to use for zero in a formula. The list of Pearson's types on p. 80 is evidently taken from the first edition of Elderton's book, and judging by the reference the new edition does not appear to have been seen. This list of types was revised many years ago and new types have been added. Yet we are still told that Type VII is the normal curve! A difference equal to 18σ gives a probability *infinitely* small, so we are told. The quantity $t = \bar{x}\sqrt{n'}/\sigma_s$ is like \bar{x}/σ_m , why, is not stated. The standard error of a difference in means is not as given on p. 110. The use of *frequency* for the number in the sample is not happy, since it has already an accepted meaning in a different sense. We are told on p. 137 that we can assume with *moderate certainty* that r is *approximately* equal to ρ . An obvious mistake is *not -A* and *not -B* for *not A* and *not B* in the table on p. 167, while there is an example of a glaring error on p. 168, where the division of the correlation table has been made in the wrong place and the headings of Table XXXIV are wrong in two ways. Table XXXV is obviously not a table of $r = 2\sin(\pi/6)$. The foregoing are only selections from a rather lengthy list of errors which have been noted. This is a pity, for a book covering the subject-matter of this one is certainly needed, many of the tests being only available in research papers, but it is evident that a good deal of revision is first required.

J. W.

2.—*New Methods of Measuring Marginal Utility*. By Ragnar Frisch. (Beiträge zur Ökonomischen Theorie, nr. 3.) Tübingen: J. C. B. Mohr, 1932. $9\frac{1}{2}'' \times 6''$; vii + 142 pp. Rm. 9.60.

"Is marginal utility a measurable thing, or is it not?" With this question Professor Frisch introduces the subject in this monograph. He also dealt with it in a paper published in 1926, *Sur un*

problème d'économie pure (reviewed in the *Journal* for 1927, p. 146), and there developed certain mathematical methods which were applied to statistical data of sales and prices collected by the Union des Co-opérateurs Parisiens. The present work is an extension of the author's previous researches.

Professor Frisch studied the money utility function as being dependent on two variables: (1) the nominal income, measured in dollars per unit of time and (2) the price of living. Professor Irving Fisher had developed a statistical method for measuring marginal utility, considering the marginal utility of money as dependent on (1) the nominal income, and (2) a large number of the price variables which determine the entire price situation. Professor Frisch, in collaboration with Professor Fisher, attempted to apply both these methods to American data available to them, at first with scant success, owing to unforeseen difficulties. The way in which these difficulties were overcome and the methods devised for this purpose are the subject-matter of a part of this paper.

The author also considers the problem of Index-Numbers and Money Utility. In the statistical problem of determining utility curves index-numbers are necessarily used. The question is, how far is the study of "utility" prejudiced by the choice of prices of articles which are selected as representative for the purpose of calculating an index-number to be used in these studies?

The connection between Money Utility and the Supply Curve of Labour, and between Money Utility and the Income Tax are also discussed, in later sections.

The whole of this monograph by a distinguished econometrician is a very interesting and stimulating piece of work, and we may anticipate further applications of these methods to statistical data in the future.

E. C. R.

3.—*Pitfalls in the Statistical Construction of Demand and Supply Curves.* By Ragnar Frisch. (Veröffentlichungen der Frankfurter Gesellschaft für Konjunkturforschung.) Leipzig: Hans Buske, 1933. 9 $\frac{1}{4}$ " \times 6"; 39 pp. Rm. 3.60.

Some would say that demand and supply curves cannot be determined from statistical data. Professor Frisch belongs to the group which conceives that they can, but he fully realizes the dangers that may beset those who attempt this task. The present paper is an effort to present the statistical problem in such a way that the difficulties inherent in it are exposed. If we are given, for instance, quantities of commodities supplied, with their prices which, when plotted, give us a group of scattered points, can we deduce the supply curves and the elasticity? This question is discussed by the author from the beginning and the various possibilities are explored. Some consideration is given to the work done by Leontief (*Weltwirtschaftliches Archiv*, July, 1929). Professor Frisch considers that Leontief's work is unsound, since, in his view, many coefficients of elasticity obtained by Leontief's method are meaningless, their magnitude being determined by "random errors" introduced into the data.

This monograph will serve a very useful purpose, in that those who believe in the application of statistical methods to the solution of these problems of demand and supply curves are given a satisfactory summary of the difficulties involved, and those who are sceptical of this methodological work will be able to criticize the assumptions on which the methods are based. E. C. R.

4.—*Sources and Characteristics of the Principal Mortality Tables.* By J. S. Elston. 2nd ed. Published by the Actuarial Society of America, New York. 1932. iv + 72 pp.

This volume forms No. 1 of a series of actuarial studies, the objects of which are to assist students of actuarial science and to furnish a ready reference for actuaries, and seems to fulfil these intentions in every way. It affords a comprehensive description of the principal mortality tables which have been produced and indicates the uses to which they have been, or are being, put. The author states in the introduction that the book does not purport to give more than an outline of the general features of the experiences discussed, and that more complete details of the technique of the construction and graduation of some of the tables are given in the companion volumes Nos. 2, 3 and 4.

Whilst it may be true that Dr. Halley published, in 1693, the first tables of any importance which are now known, it is nevertheless of interest to recall that in 1662 John Graunt constructed a rudimentary life table from the London Bills of Mortality by means of what he was pleased to term his "shop arithmetic." Chapter II deals with the population mortality tables of Great Britain and it is pointed out that it is to be regretted that Dr. Price, to whom we owe so much of the early development of scientific mortality tables, should be popularly remembered more on account of the faulty method of construction of his Northampton Table than for the valuable work which he contributed. Dr. Price himself was well aware of the difficulties with which he had to contend. It is interesting to note that as early as 1815 Joshua Milne employed a method of graduation which necessitated the construction of what would now be known as frequency curves. It is not quite clear what the author has in mind when he states that for financial calculations applicable to individuals census mortality tables do not meet present day requirements, and it should perhaps be mentioned that the later English Life Tables are widely used in industrial assurance practice and that the English Life Table No. 6 (Persons) is the basis laid down in the Industrial Assurance Act, 1923, for the calculation of statutory free paid-up policies and surrender values. Population mortality tables based upon American experience form the subject matter of Chapter III and the table given on page 37 is interesting as showing the marked inferiority of negroes in the matter of longevity.

A description of the tables formed from life insurance experience in Great Britain is contained in Chapter IV. When the volume was issued no results had been published regarding the new experience which the Institute of Actuaries and Faculty of Actuaries in Scotland

are collating. The preliminary results of this investigation have now been forwarded to the contributing offices and it is understood that full tables will shortly be published. Mention is made in this chapter of the late Mr. Morgan, and it is perhaps appropriate, as the centenary of his death fell this year, to recall that his highly original work gained for him the Copley medal of the Royal Society, and that he may be said in fact to have laid the foundations of all actuarial work. Chapter V is devoted to tables formed from American life insurance experience, whilst Chapter VI, which deals with general mortality investigations in America into the effect of occupation and medical impairment upon longevity, is of particular interest.

The chief interest in Chapters VII and VIII, in which are described the tables based on the mortality of annuitants in Great Britain and America respectively, centres in the methods of forecasting the future mortality of annuitants employed in the construction of the Government Life Annuitants Table, 1900-1920, and the British Offices Life Annuitants Table, 1900-1920, and on the shortening of the period during which it is necessary to take account of selection.

The principal mortality tables published in other countries are outlined in Chapter IX. On p. 131 the author rather conveys the idea that the Manchester Unity tables were based on the experience of disabled lives; this is of course not the case, as the members of this Society were largely of the superior artisan class and were in the main a body of very healthy lives. The appendix contains comparative tables and graphs of the principal mortality tables. The device employed in the construction of the graphs of showing $lq_x^{2/3}$ instead of q_x is very effective in rendering the curves manageable without distorting their distinctive features. C. H. L. B.

5.—*Tests for Accident Proneness.* By E. Farmer, E. G. Chambers, and F. J. Kirk. Industrial Health Research Board Report, No. 68. London: H.M.S.O., 1933. iii + 51 pp. 9d. net.

This investigation is an extension of the Industrial Health Research Board's work on the development of means by which detection can be made beforehand of such individuals as Greenwood, Woods, and Newbold have shown to be inherently liable to sustain industrial accidents. Intelligence and sensori-motor tests were applied to all the apprentices entering H.M. Dockyard at Portsmouth after 1923 and their test performances compared with their subsequent accident records over a period of five years. The results have been analysed critically and carefully by several alternative statistical methods, and, in general, confirm those of the authors' previous studies, namely that there is some association between success in the aestheto-kinetic tests and low accident rate. In these particular groups no significant relation was found between intelligence and accidents but this does not imply that such a relationship is always absent. The relation between the psychological functions involved in the tests and accident proneness appears to be not a finely graded one but a gross one, so that only extremes of goodness and badness in the test scores are positively related to

differences in accident rate. This makes the correlation coefficients and ratios given in the report somewhat less impressive than the simple division of the test data into the four inter-quartile groups and the comparison of the accident incidence within each of them. It can be seen then that if only those who were in the top three inter-quartile groups had been accepted for employment the accident rates of the trades group examined would have been lessened by ten to twenty per cent. On the other hand if only the top inter-quartile group were retained the accident rate would not be reduced by more than forty per cent., which shows that though these tests may certainly be used with advantage for selective purposes, a deficiency in aestheto-kinetic co-ordination can be only one of the, perhaps many, factors involved in accident proneness. Ultimately, with the same skill and patience as are apparent in this report, it may prove possible to isolate some of these other factors and attempts to this end are in progress. It is interesting to observe, also (in the Board's Annual Report of 1933) that tests have been given to a group of transport drivers, and that the accident records of the transport workers of a Borough Council have been examined and the men are to be tested. It is possible that, here, variations in intelligence may play some part in accident proneness, *i.e.* where accidents may be due to a failure in judgment. Also until such further data are available it is not possible to decide whether this accident proneness is general or specific to particular occupations. The results of these further investigations will therefore be awaited with equal interest.

A. B. H.

6.—*The Tourist Movement*. By F. W. Ogilvie. London: P. S. King, 1933. $8\frac{1}{2}'' \times 5\frac{1}{2}''$; xv + 228 pp. 12s. 6d.

"Tourists, from the economic point of view, are simply, in the first instance, people who move their quarters temporarily." "By the usage of the United Kingdom and many other countries, migrants are commonly defined as persons who change their residence for a year or more: tourists, therefore, so far as concerns residence, may be defined as persons who stay away from home for any period not exceeding one year." Professor Ogilvie sets out to consider the problem of measurement of the movement of tourists, thus defined, the length of time tourists stay away from home, and their expenditure. The internal movement of "tourists" is left on one side, so far as methods of measurement and estimates of expenditure are concerned—though the importance of this movement in the economy of this and other countries is noted, both in relation to hotel services and to the road and rail transport services—and the book is devoted to the problem as it affects the international balance of payments of this and other countries. Particulars are given of the estimated tourist balances of twenty-four countries for the years 1928, 1929 and 1930, with separate accounts of the tourist movement in eleven countries, some description being given of the varying methods, in some cases very ingenious (and based on precarious hypotheses), by which the tourist receipts and expenditure have been estimated. According to the estimates the country with the largest credit balance is

France, with £68 million in 1929, followed by Canada, £39 million, and Italy, £23 million, while the United States has by far the largest debit balance, estimated at £140 million in 1929.

Tourists moving from country to country may be recorded by one or both of two methods,—at the frontiers, or inside the country at hotels and other places where they are staying, but “in many ways it is a far less important problem economically to know the actual number of persons visiting a country than to know the number of days which tourists as a whole stay there.” Four distinct methods of calculating length of stay are discussed. Two of these are well known, viz. hotel and lodging records, and the questionnaire method, but the other two methods described as a Census Method and an In-and-out Lag Method are new. While a high degree of accuracy is not claimed for either method, they are each applied to United Kingdom statistics in an attempt to arrive at the balance of tourist expenditure of this country. By the former method the average length of stay is obtained by dividing the number of visitors present in the country on the date of the Population Census by the average number of visitors during the year, an adjustment being made if the records indicate that the rate of flow at about the censal date differs from the average during the whole year. By the latter method, invented by Dr. A. C. Aitken of Edinburgh University, the average date of arrival and the average date of departure are ascertained, this being possible if the seasonal variation is pronounced, as it is in this country. The difference between these two dates will represent the average length of stay, but this difference is markedly affected by the assumptions made as to what happens to persons at the beginning and end of the year. In the calculations made, the weights of the January and December arrivals and departures are each halved, but with the disturbing effect of Christmas in the figures is this assumption likely to be correct?

An estimate of the external tourist expenditure of the United Kingdom occupies a large part of the book and is a valuable attempt to obtain from the available statistics guidance as to the probable balance of expenditure. Professor Ogilvie draws prominent attention to a statement by Mr. Macrosty, who was formerly connected with the compilation of the United Kingdom balance of payments, that the amount of the item which includes tourist expenditure is “purely conventional,” but it is unfortunate that he did not realise that since that statement was made a somewhat greater degree of precision has been attempted by the Board of Trade, and, in particular, that the tourist expenditure in 1930, 1931, and 1932 was estimated in the “Board of Trade Journal” for February 23rd, 1933. The official estimate differs from Professor Ogilvie’s in two respects. The expenditure in 1930 is there stated to have differed little from the receipts, whereas Professor Ogilvie places the balance as a debit of £10½ million; the Board of Trade consider that the change between 1930 and 1931 was an increase in the debit balance amounting to about £3 million, whereas in the book the debit balance in 1931 is put at about £400,000 less than in 1930.

Foreign subjects are recorded by the Home Office on entering and leaving the country, but British subjects arriving from or departing to the Continent are only recorded by number, and since 1913 the Board of Trade have not published statistics of the permanent place of residence of the British subjects travelling to or from non-European countries. In splitting up the latter class of British subjects between United Kingdom residents and others, Professor Ogilvie makes use of the proportion ascertained for the year 1913, when the statistics were admittedly defective, but, though reference is made to the paper on Emigration read before the Society last January,* use is not made of the results, there given, of the sample investigation made for 1932 on this subject, which differ considerably from those published for 1913. The use of the later results would however tend to increase, rather than to decrease, the estimated debit balance. The Census method is used to calculate the proportion of the British passengers to the Continent who were United Kingdom residents, but as the 1921 Census only recorded place of birth and not normal place of residence of the persons enumerated, the estimate may be very widely out, as Professor Ogilvie recognises, and it would perhaps have been preferable to have refrained from publishing the book until the 1931 Census results were available, since these will enable the proportion to be estimated with very much greater accuracy.

The average expenditure of United Kingdom tourists in 1929 is estimated by the author at £100 for visitors to countries outside Europe and at £30 for visitors to the Continent, but in the latter estimate no allowance has apparently been made for the large number of passengers who travel to the Continent by day trips or for the week-end. For the main classes of visitors to the United Kingdom the average expenditure of overseas-British visitors is put at £45 and that of foreign visitors, exclusive of transmigrants, seamen in transit, students, etc., is put at £30. These figures may be underestimates, having regard to the heavy expenditure known to be incurred by many British visitors from overseas who spend a long period of leave in this country, and by the American visitors, whose expenditure in 1929 is stated to have been in excess of £50 on the average. How far it may be practicable without the institution of elaborate methods, to which objection might well be raised, to reach estimates on which any reliance can be placed, is a matter which only the future can disclose. In the meantime every credit must be given to Professor Ogilvie for his success in dealing with somewhat intractable material.

H. L.

7.—*The Agricultural Situation in 1931-32.* International Institute of Agriculture. Rome, 1933. 9½" × 7". 536 pp. 25 lire.

A comparatively recent activity of the International Institute of Agriculture has been the issue annually of a "commentary" on the economic condition of world agriculture. The present volume is the third of the series, and brings the story of the agricultural crisis up

* "Migration from and to the United Kingdom." By H. Leak and T. Priddy. Part II, 1933.

to the middle of 1932. It opens with a very interesting contribution by Dr. Pavlovsky in which he reviews on broad general lines the course of the agricultural depression. He lays emphasis on the far-reaching changes which have taken place since the war in the structure of world agriculture, industry, trade and finance, and finds in these structural changes rather than in any cyclical fluctuations the basis of the economic crisis. The most important of these changes is "the almost entire cessation of the free international circulation of goods and of the agents of production—capital, labour and enterprise—of which the free migration in search of profitable employment was one of the essential features of the pre-war economic system." The self-adjusting machinery of the world market, which used to ensure the balance of world economy, has been put out of action. It remains to be seen what is to be put in its place, but Dr. Pavlovsky concludes that "international co-operation, be it spontaneous or deliberately planned and organized, certainly cannot be dispensed with."

This study of the background of the agricultural depression is followed by a section dealing with the effects of the financial crisis of 1931, in which attention is drawn to the subsequent wide extension of measures for the control of the import trade. These affected all commodities, but the desire of European countries to assist their own farmers led to an intensification in regard to agricultural products, especially by the imposition of import quotas and the licensing of imports. An interesting table is given showing the average prices of cereals in exporting countries and in protected continental markets in 1927 and 1932, which shows that whereas the price of wheat in the former year in Berlin, Paris and Milan was only one-third higher than the export level, it was in 1932 nearly three times as much. The effect of the restrictions has, in fact, been to keep up the internal price nearly to the former level, notwithstanding the enormous fall on the free market; the consumer in these continental markets has, however, obtained some slight advantage, as the average price in 1932 was 30 gold francs per quintal against 36 francs in the earlier year.

Another section deals with various factors which have influenced prices in 1931-32. A topic of some interest touched on here is the existence, in certain countries where there is no organized unemployment relief, of a problem resulting from the exodus into the country of urban population in search of subsistence on the land.

The remainder of the volume largely consists of a narration of facts on which the preceding "commentary" is more or less directly based. It begins with a useful summary giving index-numbers of prices (reduced to a gold base) together with information regarding production, stocks, etc. for all the chief agricultural products, including wheat and other cereals; sugar, coffee, tea and cacao; wine and olive oil; cotton and other textiles; rubber; live-stock and live-stock products. It then proceeds to describe for each country separately the measures of assistance or relief taken by the respective Governments, and the voluntary action taken by producers through co-operative and similar organizations, leading up

finally to a summary of the principal features of each country's trade in agricultural products.

R. J. T.

8.—*Economic Scares*. By Edwin Cannan, Emeritus Professor of Political Economy in the University of London. London: P. S. King, 1933. 7½" × 5"; viii + 135 pp. 4s. 6d.

One of Dr. Cannan's chief delights in life appears to be the shooting of follies as they fly, and if the birds he brings down are sometimes simply clay pigeons which he has himself put up that only adds to the exhilaration and innocence of the sport. The covey this time is only four birds, "the fear of an adverse balance of trade," "the fear of insufficiency of work," "the fear of spending too much or living on capital," and "the fear of over-population." The first bird was slain long ago by Adam Smith and Hume in its guise of the "drain of gold," but since then it has been born again in a form which disturbs people who, forgetting the effect of overseas investment, are alarmed by an excess of imports. This bird Dr. Cannan brings down as dead as a door nail. But there is another fowl whose quality he does not quite see, where the balance of payments is complicated by non-commercial debts and payments, by falling prices of primary products which cause a fall in income from overseas and corresponding inability to pay for imports, and an unwillingness to invest abroad even when there are not sufficient outlets at home.

The ammunition for disposing of the fear of insufficient work is the insatiability of human wants and, in case of a failure of demand, the redistribution of employment between the different kinds of labour through the ordinary efflux of time. Unfortunately, Dr. Cannan has left out "the mobility of labour" and "the absence of economic friction." Without their help it is impossible to say that "there does not seem to be the smallest ground for the common belief that under existing conditions increase of population can outrun increase of employment. The additional workers make employment for each other." The existence of "technical" unemployment through improved machinery and organization disproves this over-simplification. The bird which Dr. Cannan has triumphantly missed is called "the maldistribution of the National Dividend." The third chapter might appropriately have been called "the Great Economy Stunt." "Down to the summer of 1931 it was commonly accepted that public authorities ought to counter booms and depressions by going slow in their enterprises in times of boom and fast in times of depression." The objection to this maxim was that it required greater level-headedness on the part of authorities than was possessed by the business community, and those who knew public authorities were aware that they have less rather than more level-headedness than their subjects. But nobody doubted the theory as a counsel of perfection. Yet in 1931 all of a sudden there triumphed the exactly contrary doctrine, that in time of depression the duty of public authorities is to be more depressed than their subjects and stop making every kind of accretion to stock and equipment which cannot be described as in the highest

degree urgent or necessary. This thesis is enforced with much incisive humour, and, incidentally, a useful survey is made of social savings which do not originate in personal surpluses of income over expenditure.

As far back as 1895 Dr. Cannan read before the Economic and Statistical Section of the British Association a paper on the probability of a cessation of the growth of the population of England during the twentieth century, and followed it in 1901 by another paper on the same subject before the same body. The increase in population, he estimated, would become "trifling in 1941-51." All authorities are now agreed as to the early advent of a stationary population, and Dr. Cannan in the fourth chapter of this book considers some of the changes in economic thought produced by the collapse of the Malthusian doctrines. The emphasis on food and subsistence which characterised the middle of the nineteenth century has gone. Improvements in transport and agriculture have reduced the importance of the law of diminishing returns. The "vampire rural landlord" has disappeared from the ranks of economic bogies. "Past history is sufficiently known to assure us that increasing civilisation has, in fact, made the aggregate share of property grow faster than that of labour," but, thanks largely to the great investment agencies of the working classes, "this question of the division of income between property and labour is losing whatever importance it possessed." "In Distribution emphasis on the old categories of land, labour, and capital is rapidly becoming obsolete and is being replaced by emphasis on individual riches and poverty, however arising." We worry about over-high wages and about unemployment, but surely it is an over-statement to say that "no longer do we think of relieving poverty by improving the terms of the general bargain which theory conceives labour as making with capital."

H. W. M.

9.—*The Value of Money.* By Tjardus Greidanus. London: P. S. King, 1932. 8½" × 5½", 364 pp. 15s.

Mr. Greidanus's book on the value of money is divided into two sections; the first consists of a survey and criticism of various writers on monetary theory, while the second part outlines the author's own theory which seeks to establish "the value of money from its interaction with the yield that money is able to produce as an instrument of trade." The essence of this theory is found in chapter XVII. Mr. Greidanus assumes a community which has just developed from the stage of barter. Each tradesman finds that by using gold, instead of replenishing his stock by barter, the profitableness of his business is increased. He will therefore find it advisable to increase his stock of money. Assuming in the first instance that there is no industrial stock of gold to draw upon he argues (p. 238) "every tradesman individually will really only be able to meet his greater demand for medium of exchange by offering more for the gold already circulating as medium of exchange. The result finally reached is, then, that the same gold obtains a higher value in exchange, and that the tradesmen on an average have the

same quantities by weight of gold in stock, but a stock of—as supposed here—double the value.” That is to say, gold prices will be halved. The stock of gold, now doubly valuable, will render greater services than previously, but these services will not be twice as great, as the tradesman will not now limit his use of gold to such urgent occasions. A point of equilibrium will finally be reached at which it no longer pays the tradesman to enlarge his stock of gold. Similar considerations apply to the consumers’ demand for gold.

The above gives Mr. Greidanus’s central thesis in its simplest form and his whole theory must stand or fall with the validity of this basic argument. The flaw in it is surely undeniable. If prices are halved, as they are on the author’s assumption, this would increase the consumers’ demand for commodities. Since, however, there is no immediate change in the supply of commodities this lower price level could not be permanent; the consumers’ competition for the existing supply of commodities would merely counteract the tradesmen’s competition for the existing supply of gold and prices would rise again. The author apparently does not recognise the foregoing argument as a possible criticism of his theory, for no attempt is made to meet it, but most readers will probably consider that a fall in prices, with the gold supply unaltered and without any change on the side of commodities, is impossible unless there is a compensatory change in the velocity of circulation. This Mr. Greidanus would not admit. In his opinion changes in velocity of circulation are merely the reflexion of changes in the profitability of holding money and it is this latter factor and not the velocity of circulation which influences prices.

It is clear from the author’s initial argument that he recognises no connection between the relative quantity of gold and commodities on the one hand and the price level on the other. Thus on p. 267 he states “in the discussion of the fundamental and permanent cause of the value of money it has been clearly set forth that the quantity of money (*e.g.* the quantity by weight of gold circulating as money) plays no part, since the profit is yielded by a quantity of value in exchange in money”—and again (p. 289) “the significance and the utility of money are not determined by the number of transactions against money.” Nevertheless he recognises that a change in the supply of gold does in fact affect prices. On p. 267 he argues that “a disproportionate increase of the production of gold” reduces the profit to be made on the medium of exchange which will consequently be offered more intensively in exchange for commodities. Again on p. 276 he refers to “the possibility of an excessive production of gold, which quite unsettles the exchange conditions of commodities for money.” What he means by a “disproportionate” or “excessive” production of gold in these two quotations is never defined. If he means a production which has increased more rapidly than the world volume of trade—and it is difficult to give any other interpretation to the words—he is in effect accepting the quantity theory of money in its broad outline. To talk of “an excessive production of gold, which quite unsettles the exchange conditions of commodities for money” and yet to

deny that there is any connection between price levels and quantity of gold seems curiously inconsistent. It is true he explains the change in prices not as the direct result of an increase in the gold supply but as due to the decreased profitableness of the additional supply. But what does this decreasing profit mean except that each unit of gold produced can only be exchanged for a smaller volume of commodities? In other words prices rise as gold output increases. Ultimately, therefore, Mr. Greidanus unconsciously comes back to the quantity theory he thinks he has disproved.

Mr. Greidanus's approach to the problem of prices is so unusual that some people may find his book worth reading for the sake of examining a new point of view. Frankly, it must be owned that to the present reviewer his theory is neither convincing nor suggestive. The first part of the book, in which the views of other writers are considered, is necessarily coloured by the author's particular standpoint. At times the criticisms are interesting, at others they seem more elaborate than helpful.

W. A. E.

10.—*Great Britain and the Gold Standard*, a Study of the Present World Depression. By H. F. Fraser, M.A., Professor of Economics in Swarthmore College. London: Macmillan, 1933. 9" × 5½". xii + 206 pp. 8s. 6d.

The first chapter, on "the pre-war theory and practice of the gold standard," gives a sufficient account of the normal working of the standard, but the second, on "war time inflation and the return to the gold standard" is not full enough to be satisfactory. Chapter III, however, brings a real contribution to our knowledge of American banking. Professor Fraser does not think that the depression and the "catastrophic" fall in prices are due to the gold standard. "It is the opinion of the writer that the fall in prices which has taken place since 1920 is perfectly natural, that is, natural in the sense that it should have been expected." "The fundamental cause of the trouble is the excessive production of wheat"; next come the delayed effects of war-time finance. With regard to the "mal-distribution of gold" it is pointed out that the American holdings were not "sterilised" but went to swell member bank reserve balances by 42.7 per cent. during a period when the gold stock of the country increased by 29.4 per cent.; those balances are the basis of credit and demand deposits increased by 36.7 per cent., investments by 67.5 per cent., and loans by 41.2 per cent. According to the wholesale price index-number of the Bureau of Labor prices were stable, but the Federal Reserve Bank of New York calculated a rise of about 10 per cent. The inflation in any case robbed the public of the benefit of lower prices, and while there was no speculation in commodities the cheap money policy created the Wall Street boom which collapsed in 1929. Incidentally, this conflict of index-numbers shows the risks of trying to control currency with the aid of this device. The folly of the United States government in continuing a tariff policy unsuited to a creditor nation and "the rigidity which has crept into the world's economic structure" have also proved great obstacles to the working of the gold standard.

Chapter IV deals with the causes and consequences of "the breakdown of the new gold standard." The international panic was not the real cause why we went off gold. "Great Britain was forced off the gold standard by the rigidity of her internal economic structure." As a "rough estimate" the pound was overvalued by 10 per cent. in 1925, and the failure to bring costs of production into relation with falling prices in the outside world endangered the balance of trade. Had nominal wages fallen in proportion to the rise in real wages, Professor Fraser thinks we might have been spared the crisis. But new ideas as to the evils of a high bank rate prevented the Bank of England from carrying out a deflationary policy.

The fifth chapter treats of "monetary and non-monetary factors in the depression," and here we are on familiar ground of controversy. Influenced, apparently, by Dr. Hayek, Professor Fraser advances a theory of the influence of bank credit on investment, where low interest rates stimulate an expansion of the constructional industries with an ultimate transfer of labour from consumption industries and a rise in the prices of consumption goods; production of consumers' goods again becomes profitable, wages and interest rates rise and constructional industries break down and initiate a depression. The resistance of highly-cartellised constructional industries to reductions in prices has only made an unbalanced situation worse.

The last chapter, on "British monetary policy and the return to gold," though only written last December, is already out of date, now that the United States is "off gold" and determined to inflate. Professor Fraser advocates a return to gold at a parity of four dollars, and adds the wise remark:—"The value of the gold standard is that it reveals an unbalanced situation and makes readjustment necessary. That is why, when all is said and done, the gold standard is *sound money*." A useful and instructive book. H. W. M.

11.—*Money, Gold, Silver and Paper*. By Francis W. Hirst. London: Charles Scribner's Sons, 1933. 7½" × 5". xiii + 272 pp. 7s. 6d.

If there is wisdom in the multitude of counsellors Chancellors of the Exchequer and ordinary men in the street should be well equipped to deal with all monetary problems, for of the making of books on those subjects there is, in truth, no end. Mr. Hirst's object, however, is not to write a "tract for the times," but "a critical history of Money from the earliest times down to the present year, using language intelligible to all who know English, without resort to mathematical formulae, or to the technical vocabulary of the lecture-room." He has, indeed, told the story of the evolution of money from barter and of the vicissitudes of currency throughout the centuries clearly and simply and in a manner that is often fascinating. So far so good, but it is not enough. The ordinary man wants to know to-day what he is to do about the pound, whether it should be tied to the franc, or should follow the dollar, or whether it is to be elevated into a new international unit for an extensive but limited area. To determine this issue he needs to consider the

relation of currency to credit and to make up his mind whether trade fluctuations are in the main due to monetary or to non-monetary causes. We cannot tell what to do with money unless we know what money does to us. Numerous writers have advanced explanations of the working of money in the past and put forward theories as to its management in the future, but their analysis has been too intricate and their language too technical to convey conviction to the man who must ultimately decide. It is just here that Mr. Hirst's gift of simple exposition would have been most valuable, but he apologises for not going into "all the controversies excited by the latest theories and projects of Dr. Gustav Cassel, Mr. J. M. Keynes, or Mr. R. G. Hawtrey" or Mr. F. Wigglesworth or Major Douglas, for lack of space. It is, therefore, pertinent to point out that he has occupied many pages in discoursing on the art of coinage, on the wampum money of the American Indians, and on inconvertible paper currencies in the colonial period of the American states and in the early years of independence. The interest of those topics is undeniable, but their discussion has led to a certain want of balance in the book. Had it been kept within narrower limits room would have been found for a more thorough explanation of the classical case of the assignats, Mr. Hirst's treatment of which is quite insufficient. He does not explain their origin, which, as S. E. Harris of Harvard shows in his valuable book, *The Assignats*, was based on the sale of church and crown lands. Many proposals for paper currencies in the 17th and 18th centuries were founded on land as a security, and an exposition of the fallacies involved would have helped Mr. Hirst in the development of his main theme of the necessity of "sound money" free from political control. A serious defect in the book is that the origin of the banknote is not explained nor the development of the cheque, so that the relation of currency to instruments of credit is left obscure. The explanation of the quantity theory of money leaves much to be desired. Mr. Hirst also should know that other United States index numbers showed a rise in commodity prices during 1924-9 although the official index number registered stability; in any case the concurrent boom in prices of securities shows that it is sometimes hazardous to measure the effect of gold by an index number based on commodity prices only.

The object of the book is to show that "experience has proved that sooner or later an inconvertible paper currency with no intrinsic value comes to grief. . . . A currency must be knave-proof and fool-proof; and to be knave-proof and fool-proof, it must be as far as possible an automatic, self-regulating currency of gold or silver, or gold *and* silver, standard money. That is the practical common sense conclusion." On account of the fallibility of human nature he does not believe in the practicability of a "managed" paper currency. "The old gold standard of England, with the free gold market, the gold bill on London, and the famous gold sovereign . . . combined efficiency with economy in a high degree," but he concludes that "convertible paper money with a good metallic token coinage is an indispensable adjunct to any satisfactory form of gold standard." He thinks, further, that silver should be "brought into play to

assist gold and enlarge the metallic basis of the world's currencies "; he does not advocate bimetallism but Marshall's plan for a sym-metallic currency, of which he gives a wholly admirable account. In order to raise prices he suggests that the chief central banks "should agree to sell every three months or every six months 1 per cent. of their gold stock, and buy therewith its equivalent of silver at the market rate. They might agree to continue this process until gold prices, measured by a reliable index number, had risen all over the world to the average level of 1925. When that was achieved, the operation would cease." A very simple plan, but its author, for the benefit of the unlettered, might have explained in some little detail how it would work. H. W. M.

12.—*This Money Business*, A Simple Account of the Institutions and Working of the Banking and Financial World. By Barnard Ellinger, C.B.E. London: P. S. King, 1933. $8\frac{3}{4}'' \times 5\frac{3}{4}''$; iv + 141 pp. 6s.

Few persons can afford to buy the two volumes of evidence given before the Macmillan Committee, and fewer, probably, have read and digested the "over one million words" which Mr. Ellinger says they contain. From these volumes he has drawn material for a clear and simple description of "the machinery of banking and finance." This had already been done by the Committee in their Report, but Mr. Ellinger, with the children and wayfarers in economics before his mind, has simplified and explained still further. It must not be supposed that his book will enlighten the incurably dull, for to understand the simplest financial operations requires some intelligence and some application. Given these, the student of economics, the manufacturer who wishes to know the connection of his business with "the City," and the puzzled man with the morning newspaper will find Mr. Ellinger a patient and trustworthy guide.

Beginning with a brief account of the gold standard, Mr. Ellinger then proceeds to explain bills of exchange and the working of the accepting houses and the discount market. Next the issuing houses are described, with the lamentable moral that investors in foreign loans are more effectively protected by the reputation of the houses that put such securities on the market than are investors in British securities. The joint-stock banks have two chapters devoted to them, while the Bank of England takes three. Two chapters of "general conspectus" bring all these sections of the financial organisation into relation with one another, the various money markets being co-ordinated through the rate of interest. The last two chapters deal with the "fundamentals of a gold standard" and the prospects of Britain returning to a gold basis. The effects of a price level which is maintained at too high an average by the relative rigidity of money wages are well brought out. It is also made clear that, whatever happens, some one must suffer. We cannot get back to the old parity on account of the rigidity of prices and wages, but we can revert to the gold standard at a lower parity. In this way, while money wages remained the same, real wages

would be reduced. "There has been since 1928 a far greater fall in the cost of living than there has been in wages, and it is possible that we might allow our prices to rise again to the 1928 level without finding it necessary to raise our money wages. That is to say that people would enjoy the same standard of living as in 1928, but it would be a lower standard of living than that which they would enjoy to-day if they were fully employed." Alternative bases for currency are discussed, but we miss an account of Marshall's "symmetallism."

It will be seen that the scope of the book is considerable, but within the limits of the purposes which the author put before himself it offers singularly few points for criticism. When writing of the "sterilisation" of gold in the United States, it is well to remember that American manufacturers, warned by the experiences of 1919-22, avoided speculation in commodities during 1923-9 and devoted themselves to reducing expenses by rationalisation so as to keep prices steady; meanwhile prices of securities and real estate rocketed through the cheap credit based on the new gold. On page 87 it is an economy of statement to say that out "of this 24 per cent. of increased bank advances, 20 per cent. went into the fixed deposit accounts, and not into the current accounts," the truth being that the borrowing from the banks was done by one set of persons who were able to use the loans, while the payments into deposit accounts were made by people who were unable to use their surplus takings (or even part of their working capital) in their own business. There also seems to be something wrong with the figures. The increase in the average monthly amount of advances by the London Clearing Banks between 1924 and 1929 (the period referred to) was £189,778,000 or 24.5 per cent., while the increase in deposit accounts was £132,614,000, which is nearly 70 per cent. of the increase in advances. Current accounts actually decreased by almost £10,000,000. Mr. Ellinger might expound the relation of these figures to an improved business situation in somewhat more detail in the second edition which is certain to be called for soon. In conclusion, as our readers know, Mr. Ellinger is a Fellow of this Society and a former member of Council, facts which add to our pleasure in congratulating him on an excellent piece of work.

H. W. M.

13.—*Future Trading upon Organized Commodity Markets in the United States.* By G. Wright Hoffman. London: Humphrey Milford: Oxford University Press for the University of Pennsylvania Press, 1932. 9 $\frac{1}{4}$ " \times 6 $\frac{1}{4}$ ". xviii + 482 pp. 28s.

The majority of the published work available regarding future trading is of one or other of two types. In the first place there is the general descriptive treatise which traces the development of future trading and of the various laws which have been passed to restrict or regulate the practice, and then passes on to a description of the modern commodity exchange, the method of buying, selling and clearing contracts, together with a consideration of the types of business interests—speculation, hedging, etc.—involved. The second class, typified by the reports of the U.S. Department of

Agriculture on the working of future exchanges, deals with some particular aspect of future trading from an analytical standpoint.

The present work by Dr. Hoffman is divided into two parts. Part I—Organization and operation of future markets—is a typical descriptive treatise on the evolution and working of organized commodity markets, but it is in Part II—Price aspects and problems of future trading—that the author makes a really valuable contribution to the literature on future trading. It is true that many of the problems he considers have been dealt with by other writers, while some have been treated more exhaustively by United States government enquiries, but it is doubtful whether within the limit of a single work there is available a critical analysis of the many aspects of future trading equal to that presented by Dr. Hoffman.

Although commodity exchanges are now a well-established feature of the commercial world, particularly in the United States, they have been, during the past, and in some quarters still are, subjected to intense criticism. The arguments advanced by the advocates of future trading to justify the practice invariably lay great stress on the value of hedging as an insurance against major price fluctuations. The general assumption underlying hedging is that by setting up equal and opposite positions in futures to those held in the actual commodity (for example, a grain elevator company buys wheat and sells an equal quantity of futures and later buys futures when it disposes of the wheat) a loss in one market is offset by a gain in the other. In this way the smaller but more certain gain from merchandising or manufacturing is substituted for a larger but more uncertain gain which is dependent on the favourable movement of prices. In practice hedging is by no means as simple and straightforward or as effective as the advocates of future trading and many of the writers on commodity exchanges would have us believe. While in the larger and principal price movements cash and future prices advance and decline together, there are many factors affecting the day-to-day movements of the spot and future markets, and it frequently happens that the firm employing the hedge makes an unexpected profit or sustains an unexpected loss through the temporary disturbance of the relation between the two markets. The author examines in detail this question of the inter-relation between cash and future prices and its bearing on hedging, and it is interesting to note that his own opinion is that it is doubtful whether hedgers as a group retain the benefit of such insurance as is afforded by hedging. He says, "By hedging they are able to borrow more freely and to extend their capital over a wider area, to reduce their per unit cost of operation. It is likely that the benefit of this lower cost, through the force of competition, is passed on either to the consumer in the form of lower prices or to the producer in the form of higher prices or partly to both."

Dealing with the much-debated question of whether future trading helps to minimize price fluctuation Dr. Hoffman returns a verdict of not proven. One aspect of future trading which rarely receives more than cursory consideration is the effect of the clause

in future contracts providing for the optional delivery of a number of different grades of the commodity. This is fully treated in a chapter on "Different systems and their effect on future prices." The author holds no brief for commodity exchanges or for their opponents, but throughout the work preserves a keen and well-balanced sense of judgment, setting out both the advantages and shortcomings of the present system of future trading and from time to time discussing lines of improvement in organization or method. G. R. W.

14.—*A Contribution to the Study of International Comparisons of Costs of Living.* International Labour Office. London: P. S. King, 1932. $9\frac{1}{2}'' \times 6\frac{1}{4}''$. xii + 246 pp. 7s. 6d.

Those in charge of the enquiry, of which this publication is the result, were well aware of the many difficulties underlying an attempt to compare the cost of living, as it affects a defined class in a number of countries at the same period of time. The reader may therefore be confident that every care has been taken to make this investigation as accurate as possible. It is well known that such "cost of living" enquiries, even those taking place in the same country over a period of time, are better described than measured; it will be the reader's fault therefore if, in spite of the warnings mentioned in the opening pages, he draws erroneous or fallacious conclusions from the mass of statistical records which are necessarily given.

This study was originally published in December 1931, but in this second edition the title has been altered and the summary of results modified and expanded. Originating in a request from the Ford Motor Co. the enquiry was especially undertaken, with the financial assistance of the Twentieth Century Fund Inc., to ascertain how much would need to be expended by the workers in 14 European cities if their general standard of living were to be approximately equal to that of a Detroit worker whose expenditure in 1929 was about 1,720 dollars. The organisation of the work is discussed in the short first chapter where also the scope of the enquiry is generally considered. The technique employed is described and a summary of results is given in Chapter II. As it was not possible to conduct a simultaneous enquiry in each city, the data collected during 1930 and 1931 have been corrected to a uniform date—January 1931, although it is admitted that the national character of the correcting factors used was not directly applicable to the data for individual towns. Details of the methods adopted are given in respect of food, housing, fuel and light, clothing, medical expenses, miscellaneous expenses, insurance and taxation. The detail involved may be illustrated by the fact that to obtain comparable prices in the food group, not only was the quality and grade of the Detroit article described as far as possible but, in addition, each foodstuff was analysed for caloric value and protein, calcium, phosphorus, and iron content. In each case prices were based on a large number—in some cases, several hundreds—of quotations. The international comparison of the cost of housing presented considerable difficulty since the predominant type of the worker's dwelling in Detroit (an exclusively occupied detached

house, equipped with electricity, gas, central heating and a bath room) was very rarely to be found in most of the European towns. To secure the maximum degree of comparability with regard to clothing, actual samples of garments as worn by the Detroit families were circulated for their guidance to the collaborators in the European cities. The measures taken with regard to the costs of fuel and light, medical expenses, life insurance and miscellaneous expenditure are similarly described in detail.

The results show that taking the Detroit cost of living as 100, the relative figures for the European cities ranged between the two extremes of Barcelona at 57 and Stockholm at 98-104. If direct taxation be excluded the European range becomes 52 to approximately 95. Full details of all data collected in each city and of results comprise the bulk of this publication. The authors are very emphatic that the work shall nowhere be taken as an indication of the general level of wages for the particular category of worker considered. This is one of the most interesting publications yet issued by the International Labour Office. The enquiry was clearly undertaken by very competent persons.

R. F. G.

15.—*The Industries of Greater London*. By Douglas H. Smith, B.Sc. (Econ.), Ph.D. London: P. S. King, 1933. 8½" × 5½"; vi + 188 pp. 10s.

It is often said that the industrial centre of gravity of England is shifting from the north to the south. Certainly to any one familiar with the new arterial exits to London the post-war growth of factories along these routes has been very striking. From many aspects, it is important to know how much this industrialisation is likely to be accentuated in the next decade or two, how far it is affecting the basic industries of the north and midlands, and what influence it may have upon the distribution of population. As a contribution to these problems Dr. Smith has spent four years in making a field-study of the industrial development during the last thirty years of the north-west quadrant of Greater London, i.e. a section bounded on the east by the Lea Valley extending from London to Ware and on the west by the Thames Valley extending from London to Windsor. Attention has been mainly directed to industries which are engaged in the manufacture of products for a national or international market, industries, that is, which might have grown up in other industrial parts of Great Britain. Information was obtained both by questionnaire and by personal interview with factory officials. Up to 1914 there were some 150 factories operating in this region whereas to-day the number is approximately 600. This growth has been influenced very largely, it is found, by the decentralisation of London's manufacturing industries, while an important part has been played by the creation of new light industries engaged in the manufacture of proprietary articles and the establishment of "assembly" industries for products obtained from other parts of England or from abroad. The study shows clearly that there is, so far as this region is concerned, but little evidence to support the belief in a southward migration or

that the manufacturing firms are encroaching on the industrial activities of other parts of the country so far as the types of industries are concerned. Rather are the industries those in which London has always had a large share of the national output, *e.g.* musical instruments, electrical equipment, foodstuffs. Their spread into Greater London is, as Dr. Smith points out, no bad thing from the point of view of health. "The rapid growth of modern hygienic factories in Greater London, with the possibility of improvements in the social amenities of life of the workers through housing estates, the equipment of sports grounds attached to the factories, are forces which herald the abandonment of slum life in London and the sordid environment in which so many have been condemned to spend their lives where crowded dwellings have been wedged in between tall unhealthy factories" (p. 184). The essential corollary to this decentralisation is obviously a far-seeing control of development. So far haphazard growth has been more characteristic of the area. For instance, in West Middlesex "factory sites are dotted somewhat indiscriminately around areas of residential growth, and in too many cases dwelling-houses have been erected in close juxtaposition to factories regardless of the efforts of town planning organisations" (p. 77). Without control the last state may, in time, be worse than the first. This careful investigation shows the many factors that the planner must take into account; it indicates, as Sir Raymond Unwin points out in his preface, the kind of information which ought to be available for the whole of the London region, and for many other districts where industrial expansion is taking place, or where efforts to promote it are needed. Easy road transport, the distribution of cheap electric power (which no longer necessitates the concentration of industry near sources of power), cheaper land and lower rates, must inevitably lead to the exploitation of more rural areas—"a movement which is all to the good, provided we do not perpetuate on the fringe of Greater London the evils which have been allowed full play in certain parts of London itself." Dr. Smith has given an interesting and very readable—though not altogether comforting—account of the development of one particular area.

A. B. H.

16.—*The Incidence of Work Shortage.* By Margaret H. Hogg. New York: Russell Sage Foundation, 1932. 9" × 6". 136 pp. \$ 2.50.

This is a report by Miss Hogg of a Survey of Unemployment in New Haven, Connecticut, at May-June, 1931, under the direction of the Statistical Department of the Russell Sage Foundation. The method of survey was by investigation of the position of 2,097 households drawn at random from the New Haven Gas Company's list of households. The sample is said to be one of 5.08 per cent., but it is not clear whether the percentage is of the households or population of New Haven. The population of New Haven does not appear to be given anywhere in the report, but the number of gainful workers over sixteen is stated to be over 68,000. Of these it was estimated, as a result of the survey, that about 11,000 were idle at

May-June, 1931 (*i.e.* able to work and wanting work), and some 2,000 had not worked a day for at least a year. In addition, another 11,000, although working, had had less than full work for the week previous to the date of the visit. The calculated unemployment rate is given as 17½ per cent. (men 19½, women 14½). To obtain a true unemployment rate, however, some addition has to be made on account of those without full employment, *i.e.* unemployed on one or more working days each week. It is not clear what this addition should be, but from an examination of tables in Part II of the Report it might well be as much as 8 per cent. On the other hand, although the term unemployment is taken as meaning "those idle from want of work," it is not quite certain whether the calculated rates given above exclude earners who while ordinarily employed were at the time idle from sickness or unwillingness to work (*see* note p. 29).

The classification of the unemployment by occupation is too general to enable any but very broad conclusions to be drawn. Unemployment was found to be highest among unskilled male workers, as was to be expected. Of the industries, the building and construction of works trades were hardest hit, and, in spite of the time of year being favourable to such trades, only 67½ per cent. of the men were at work.

The Report contains forty statistical tables, analyzing the material of the survey, and three appendices, the first of which gives the evidence as to the representativeness of the sample studied, which appears to be so well demonstrated that it was hardly necessary to devote several pages at the beginning of the Report in order to convict another survey of a failure in this respect. The third appendix contains suggestions for the preparation of questionnaires and the tabulation of results, based on the experience of the New Haven survey, and is well worth study. W. A. B.

17.—Other New Publications.*

Bouniatian (Mentor). Les Crises Économiques: Essai de Morphologie et Théorie des Crises Économiques Périodiques. 2nd ed. française. Paris: Marcel Giard, 1930. 9" × 5½"; xviii + 430 pp. 60 fr.

[This book was originally issued in 1908 in German, and was reviewed in the *Journal* for that year; translations into Russian and French appeared in 1915 and 1921 respectively, and the latter was reviewed in the *Journal* for 1922. In revising the present edition the author has made many alterations in the text and footnotes in accordance with readers' criticisms and suggestions. The tabular matter has been brought up to date and a diagram showing the correlation between prices and unemployment has been added. There is an excellent index as well as the usual table of contents.]

"*British-Indian*." Finance and Commerce in Federal India. Oxford University Press, London: H. Milford, 1932. 7½" × 4½"; 171 pp. 5s.

[The author has aimed at presenting an "independent and constructive study" of the financial and commercial aspects of the problem of

* See also "Additions to Library," pp. 729 foll.

Indian Federation. The treatment is practical and detailed, political and not statistical. Section I, Finance, goes into the questions of machinery for voting supplies, of capital and debt transactions, loans, exchange and currency, etc. Section II deals with commerce, and includes chapters on individuals and firms carrying on business in India, and British Trade with India. Section III is on Federal Finance—the federal budget, residuary powers of taxation, etc. The preface concludes with a statement of hope and belief that England and India will find a way of working harmoniously together for the establishment of a wise constitution.]

Brown (C. H. L.) and J. A. G. Taylor. Friendly Societies. Published for the Institute of Actuaries Students' Society by the Cambridge University Press, 1933. $8\frac{1}{2}'' \times 5\frac{1}{2}''$; xii + 95 pp. 7s. 6d.

[This book is the second of a series that is being produced by the Students' Society of the Institute of Actuaries with the object of introducing actuarial students to certain branches of work included in the syllabus for their examinations. It describes the nature of Friendly Societies and the kinds of benefits granted, and indicates the legislation by which they are regulated and the returns that have to be made to the Registrar of Friendly Societies. The book also describes the way the experience of a society should be investigated and its liabilities valued. In view of its object, it will appeal mainly to actuarial students, but many actuaries who have long since ceased to be troubled by examinations will welcome it as a helpful exposition of a somewhat difficult subject. Outside actuarial circles it will be read by those who take a whole-hearted interest in Friendly Societies and may be, in some way, responsible for their welfare or management. The book is well arranged and thoroughly reliable. It can be recommended whole-heartedly.]

Cornelissen (Christian). Traité Général de Science Économique. Tome II. Théorie du Salaire et du Travail Salarié. 2nd ed. Paris: Marcel Giard, 1933. $9'' \times 5\frac{1}{2}''$; 724 pp. 90 fr.

[In the review of the first edition, in the *Journal* for 1909, while the accuracy of the author's observations of the facts concerning wages was accorded due recognition, the theory he based upon his interpretation of those facts was severely criticized. In the preface to this edition M. Cornelissen shows himself not only quite unconvinced but able to regard the far-reaching changes which have occurred since the war as providing additional support for his theoretical structure. The treatise has been brought up to date, historically, but the abnormal wage conditions of the war period have been, for obvious reasons, ignored in the general account and treated in a separate chapter. The only other entirely new chapter is devoted to a consideration of the various factors responsible for the post-war alterations in both the productivity and the remuneration of labour, the largest amount of space being devoted to Taylorism and the rationalization of industry.]

Dalla Volta (Riccardo). Scritti Vari di Economia e Finanza. Pubblicazioni del R. Istituto Superiore di Scienze Economiche e Commerciali, Firenze. Int. Seeber, 1931. $10'' \times 7''$; 624 pp. Lire 40.

[The thirty papers in this collection of Signor Dalla Volta's scattered writings, intended chiefly, he says, for students, were written and originally published at dates ranging from 1888 to 1928. The topics are as varied as the dates. The earliest paper, "Letters of Ricardo to Malthus," is a review of Dr. Bonar's book, the two latest are on the Gold Exchange Standard and the Theoretical Basis of Co-operation, respectively; others deal with tariff problems (1904 and 1922), emigration (1916 and 1926), the syndical and corporative State (1927) and Professor Moore's

theory of economic cycles (1919), while the volume ends with "Towards Peace and Prosperity in Europe." The essays show the author's sanity and breadth of outlook, and while the subjects are for the most part touched with a light hand, the opinions set down imply the solid foundation of economic study on which they are based.]

Heckscher (Eli F.). En Befolkningsstatistik från det adertonde århundradets första halft (Swedish Population Statistics of the first half of the 18th century). $9\frac{3}{4}'' \times 6\frac{3}{4}''$; pp. 123-140. Reprint from *Nationalökonomisk Tidskrift*.

[The official population statistics of Sweden begin in 1749, but annual figures of births and deaths exist throughout the country from 1736 onwards. When the bishops were required in 1736 to furnish from the parish registers figures of births and deaths back to 1721, Stockholm and nine provinces gave annual figures, the other bishoprics only an aggregate for the period. The author has endeavoured to give estimates of the absolute population and the birth and death rates back to 1720. His method has been to take the official figures of 1749 and subtract and add, respectively, the births and deaths of previous years (immigration and emigration being considered negligible). The results are shown in three tables and three diagrams; all have headings in English, and there is an English summary of the Swedish text.]

Kohri (Kikunosuke). General Features of the Index-Numbers in Japan. Printed in New York, March 1932. $8'' \times 6''$; 11 pp.

[A brief but informative description, by the Professor of Statistics at Nagoya Commercial College, of the various index-numbers published in Japan. The earliest of these was the wholesale price index initiated by the Committee for Monetary Research in 1895. The Nippon Ginko index of wholesale prices in Tokyo began a little later. There is now a variety of wholesale price indices besides the official national one, published by the Department of Commerce and Industry. The same Department issues indices of retail prices and of wages; the Central Statistical Bureau compiles another wages index and a cost of living index. The Nippon Ginko, besides the new wholesale price series, based on 1914, which is largely in use for international comparisons, issues indexes of retail prices, wages, and employment. There are various local and privately compiled indices of prices and wages; the Nagoya College publishes an index of Production and Foreign Trade; and the latest addition to the list appears to be a composite Index of Business Cycles calculated, on Professor Persons's method, by Mr. I. Tamura, the components of which are: the Nippon Ginko Index of wholesale prices, paper money in circulation, import and export values, bank clearings, and loans of the Nippon Ginko.]

Lyon (Stanley). The organization of official statistics in Saorstát Éireann and in some other countries (reprinted from the Journal of the Statistical and Social Inquiry Society of Ireland), 1933. $9\frac{1}{2}'' \times 6''$; pp. 29-61.

[A very large amount of definite information has been packed with great skill into the thirty-three pages of this paper. After a brief introduction describing the nature and defining the uses of statistics, Mr. Lyon gives what may be called a descriptive catalogue of Free State statistics, for which he himself, as Director of the Statistical Branch of the Department of Industry and Commerce, is mainly responsible. First, we are given an account of the beginnings and present organization of the statistical service in general, and, next, particular information as to the work done and the methods used in the various categories of statistics. The several official statistical publications of the Branch are then named and the contents of each described, and there follows a list of the statistics compiled and published by other departments (as by-products of

their administrative work, with the exception of the vital statistics). Notes on International statistical organizations and conferences complete the first part. The second consists of summary accounts of the official statistical services of fourteen other countries.]

Reid (Leonard J.). Britain and the War Debts. London: Herbert Jenkins, 1933. $7\frac{1}{4}'' \times 4\frac{3}{4}''$; 108 pp. 2s. 6d.

[Sir Robert Horne in his foreword remarks that most people are ill-informed on the subject of war debts, and in compiling this book (most of which appeared originally in columns of the *Daily Telegraph*) the author's aim was to present an "involved and intricate" problem in a form easily intelligible to the general reader. After briefly describing Great Britain's war-time financial policy and how the debts were incurred, the author gives a lucid account of the facts concerning the Anglo-American debt question, from the time America entered the war to within a few weeks of the British Delegation to Washington early this year. He discusses the war debt funding and its effects, and explains, from a British point of view, but not entirely neglecting the American, the part played by Britain as debtor and creditor, and the reasons why the general opinion in this country is opposed to continuing the payments "on any large scale or for any length of time." Appendices contain the Balfour Note and the British Note to America of December 2, 1932.]

Revue des Sciences Économiques et Financières. Athènes: Éditions Dimitracos S.A. $9\frac{1}{2}'' \times 6\frac{1}{2}''$. Annual subscription 80 fr.

[This review, one of the latest economic quarterlies, is a Greek publication which was started in 1932. The contents are divided into: I. *Articles* comprising papers on current economic questions; II. *Chroniques*, chiefly records and discussions of facts and figures, including official returns; III. *Études Statistiques*; IV. *Comptes rendues critiques*; section V consists of brief summaries, in French, of the papers in section I. Among these may be mentioned *Base mathématique des baromètres économiques* by C. Athenassiades, and *Les bases du système fiscal en Grèce*. A permanent feature of section III is an "economic barometer" of Greece.]

Sutch (William Ball). Price-Fixing in New Zealand. New York: Columbia University Press (London: P. S. King), 1932. $8\frac{3}{4}'' \times 6''$; 164 pp. 15s.

[A survey of state control of prices and commodities in New Zealand during the war and post-war period—its effects and effectiveness. From experience gained there and in other countries certain general principles of commodity control have been evolved, and these are discussed, with their particular application to New Zealand, in the first chapter. Briefly, they are the necessity for government control at every stage, for a thorough understanding of conditions prevailing when assuming or relaxing control (England, it is pointed out, suffered violent market fluctuations in some commodities through not appreciating this point), for examining the market for a given commodity in relation to that for its substitutes, for adequate powers of investigation and publicity, and for some central body to supervise and co-ordinate the work of different departments and to adopt some fundamental principles such as the basis for determining profits. Separate chapters are devoted to discussion and criticism of the Government's control of sugar, butter, building materials, and wheat, while its control of hides, footwear, petrol, potatoes, coal, milk, meat, bacon and ham, and groceries are dealt with more summarily in another chapter. The author concludes that the New Zealand Government's administrative control was excellent after initial mistakes and difficulties had been overcome; it was successful, too, on the distributive side, but its fixation of prices did not give an adequate return to capital. In his opinion, if the state is permanently to undertake trading operations, it should

not work on a fine margin of profits. State enterprise may fail on the productive side, but in distribution many economies can be effected. Two appendices contain respectively New Zealand Control Legislation and Index-Numbers of Prices. There are also a bibliography and an index.]

Wilson (Roland). Capital Imports and the Terms of Trade, examined in the light of sixty years of Australian borrowings. Melbourne: Melbourne University Press in association with Macmillan & Co., 1931. 8 $\frac{3}{4}$ " \times 5 $\frac{1}{2}$ "; viii + 112 pp. 6s. 6d.

[The author of this book has been carrying out an investigation of the economic effects of the import of capital into Australia, New Zealand and Canada and has previously published articles on different aspects of the subject in the *Economic Record* and the *Canadian Historical Review*. The present work, which is confined to Australia as regards its data, is presumably the forerunner of a more extensive study. Following a short introduction the author plunges into a calculation of Australian capital imports from 1871 to 1930 and then goes on to discuss net and gross capital imports. Chapter IV is devoted to the theory of international capital movements and the barter terms of trade, while in the final chapter the author returns to his Australian data and discusses capital imports and sectional price movements in that country during the period 1870-1930.]

CURRENT NOTES

On page 709 we give our usual table summarizing the overseas trade of the United Kingdom for the years ended July, 1932 and 1933. The excess of imports over exports of merchandise during July (£19·5 million) was about the same as a year earlier (£19·3 million). For the first seven months of the year the import excess amounted to £139·2 million, or £24·5 million less than in January–July, 1932. In Part III of the Journal a tentative estimate was made that the import excess for the whole year 1933 might be in the neighbourhood of £240 million. The latest figures indicate that this estimate may be slightly exceeded.

The value of the total imports during July was £53,706,000, and differed little from the monthly average for this year, though normally imports decline considerably in the summer months. Compared with July, 1932, imports showed an increase of £1·8 million, resulting from a marked increase in raw materials, a smaller increase in manufactured articles and a considerable decline in food, drink and tobacco. Re-exports were also larger, by £1,019,000, than in July, 1932, while transshipments under bond increased by £234,000.

Retained imports of food, drink and tobacco during July were valued at £25,363,000, or £2,712,000 less than a year earlier. An increase in value was recorded in respect of meat, due primarily to a decided increase in the average price of the bacon imported and to a smaller extent to increases in the quantity and average price of mutton and lamb. Imports of bacon and of beef were smaller than in July, 1932. Imports of wheat were also less than a year earlier, but wheat flour and other principal descriptions of grain showed a considerable increase. Among other foods, imports of sugar were about the same as in July, 1932, but there were declines, in some cases substantial, in imports of tea, butter, cheese and eggs. There was a small increase in the quantity of unmanufactured tobacco imported, while for the first seven months of the year retained imports increased by 25 per cent.

All except four of the groups of raw materials showed an increase in the value of retained imports in July compared with a year earlier, but two-thirds of the increase of £3,063,000 was due to cotton, retained imports of which increased in value from £1,397,000 to £3,453,000, imports increasing by £2,157,000 and re-exports by

£101,000. This increase was due partly to greater quantities imported and retained and partly to a rise in price. A large increase of about £400,000 was recorded in both imports and re-exports of undressed hides and skins, imports and re-exports of raw wool were also much higher than in July, 1932, while as regards copper ore, tin ore, flax, hemp, jute, and wood pulp, there was a marked expansion of imports.

Retained imports of manufactured articles were valued at £10,947,000, being £360,000 more than in July, 1932. While there were increases in nearly half the groups, these were small except in the case of the non-ferrous metals group, imports of which increased by £733,000 or 95 per cent., and re-exports by £144,000. Aluminium, copper, lead and zinc all showed substantial increases compared with a year earlier. Decreases were recorded in the various textile groups, except cotton, in iron and steel, machinery and vehicles, in electrical goods, leather, rubber manufactures and paper, cardboard, etc., the decline in the last named group (£215,000) being much the largest. The only other large decrease was £117,000 in respect of iron and steel.

Exports of United Kingdom goods during July amounted to £29,847,000, showing an increase of £554,000 compared with a year earlier and of £543,000 compared with the average for the first seven months of the year. Exports of food, drink and tobacco were about the same as in July, 1932, there was a decline of £120,000 in parcel post, and increases of £401,000 in raw materials and £343,000 in manufactured articles. The quantity of coal exported amounted to £3,271,000 tons, being 2 per cent. less than a year earlier, while the value declined by £129,000 (5 per cent.). The decline in exports to the Irish Free State and France was very marked, over 110,000 tons in each case, but there were considerable increases in exports to Sweden, Germany and Denmark.

Exports of raw wool, wool waste, wool noils and woollen rags were each much more than double those in July, 1932, and the increase in value for the wool group as a whole was £366,000. A marked expansion in each of these items was recorded for the seven months ended July, the value this year being about £900,000 more than in either 1931 or 1932. An expansion was also recorded in exports of woollen and worsted yarns and manufactures, the value of such exports during July being 9 per cent. higher than a year earlier. For the seven months ended July, the quantities of tops, yarns, tissues and carpets exported were in each case larger than in either 1931 or 1932.

Movements and Classes.	Twelve Months ended 31st July, 1932.	Twelve Months ended 31st July, 1933.	Increase (+) or Decrease (—).			
Imports, c.i.f.—	£'000.	£'000.	£'000.			
Food, drink, and tobacco	398,656	350,498	(—) 48,158			
Raw materials and articles mainly un- manufactured	169,398	162,724	(—) 6,674			
Articles wholly or mainly manufac- tured	209,710	147,371	(—) 62,339			
Other articles	8,294	3,681	(—) 4,613			
Total Imports ...	786,058	664,274	(—) 121,784			
Exports, f.o.b.—						
<i>United Kingdom Produce and Manufactures—</i>						
Food, drink, and tobacco	33,405	29,416	(—) 3,989			
Raw materials and articles mainly un- manufactured	44,689	44,287	(—) 402			
Articles wholly or mainly manufac- tured	280,579	267,604	(—) 12,975			
Other articles	14,868	12,631	(—) 2,237			
<i>Imported Merchandise—</i>						
Food, drink, and tobacco	17,884	12,221	(—) 5,663			
Raw materials and articles mainly un- manufactured	23,217	24,277	(+) 1,060			
Articles wholly or mainly manufac- tured	14,347	11,061	(—) 3,286			
Other articles	410	231	(—) 179			
Total Exports ...	429,399	401,728	(—) 27,671			
Bullion and Specie—						
Imports	152,499	210,895	(+) 58,396			
Exports	151,357	106,543	(—) 44,814			
Movements of Shipping in the Foreign Trade—	Number of Vessels.	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.
<i>Entered with cargoes—</i>						
British	27,050	36,994	23,521	34,972	(—) 3,529	(—) 2,022
Foreign	24,698	23,173	22,406	20,873	(—) 2,292	(—) 2,300
Total entered ...	51,748	60,167	45,927	55,845	(—) 5,821	(—) 4,322
<i>Cleared with cargoes—</i>						
British	34,441	36,476	29,391	33,661	(—) 5,050	(—) 2,815
Foreign	19,240	20,307	19,297	19,152	(+) 57	(—) 1,155
Total cleared ...	53,681	56,783	48,688	52,813	(—) 4,993	(—) 3,970

The quantity of cotton piece goods exported was 43·6 million square yards (22 per cent.) less than in July, 1932, there being a fall of 30·6 million square yards in exports to India. Countries showing an important expansion in exports were Argentina, British South Africa, Switzerland, Colombia, and Denmark, and the exports to each of these markets were larger in January-July than a year earlier. Exports of cotton yarns were about 10 per cent. greater than in July, 1932. There was also an increase in exports of linen and jute piece goods but a slight decline in artificial silk tissues.

The tonnage of iron and steel and manufactures thereof exported declined by about 1 per cent., but the value increased by a like proportion. For the seven months, there was a small decline in both value and tonnage. Exports of machinery were 12 per cent. smaller in tonnage than in July, 1932, but exports of locomotives showed an expansion from the very low level of last year. The number of motor cars and chassis exported though slightly less than in June, was nearly 50 per cent. greater than in July, 1932. Another important commodity exports of which have been very high during this year is tin blocks, bars, etc. Exports during July were valued at £915,000, of which £771,000 represented exports to the United States. The quantity exported to that market was six times as great as in July, 1931 or 1932, and the value increased more than tenfold. In respect of a number of other commodities an increase in exports to the United States is recorded.

The volume of exports in the second quarter of the year, as calculated by the Board of Trade, was about 6 per cent. below that in the corresponding quarter of 1932. To a considerable extent this was due to Easter being in the second quarter of this year and in the first quarter of last. For the first half of the year the decline in the volume of exports was 3·4 per cent., and making allowance for Easter it would appear that relative to last year the results for the second quarter may have been better than those for the first quarter. The value of exports during the three months ended July was £89·0 million this year and £89·2 million last year, and having regard to the fall of over 3 per cent. in average values shown by the latest available figures, it would seem probable that the volume of exports for this period was greater than a year ago. Notwithstanding the decline in total exports of United Kingdom goods, exports of raw materials last quarter were 5 per cent. greater in volume than in the second quarter of 1932, the increase being mainly attributable to a

marked expansion in exports of raw wool, wool waste, etc. Retained imports showed an increase of nearly 4 per cent., and, contrary to the usual seasonal movement, were greater in the second quarter than in the first. The last mentioned increase was due in the main to a considerable increase in imports of manufactured articles, but retained imports of food, drink and tobacco were also larger. Compared with last year, all the three principal classes of merchandise showed increases.

Imports of bullion and specie have continued at a very high level, imports during May, June and July averaging £934,000 a day. The excess of imports over exports during the seven months ended July amounted to £105,701,000, compared with an import excess of £21,130,000 in the corresponding period of last year, while for the twelve months ended July imports of bullion and specie exceeded exports by £104,352,000.

During the three months ended July, 1933, the general level of wholesale prices has advanced appreciably. As measured by the Board of Trade index-number (1930 = 100) there was a rise of 5·3 per cent. over the period, the index for the month of July being 85·6 compared with 81·3 for the month of April. Towards the end of July, however, prices of a number of commodities showed a tendency to decline. This was most noticeable in the case of meat, but cereals have continued to advance and for July were about 8 per cent. above prices for April. Over the period the most noticeable advances were for wool (21 per cent.), cotton (12 per cent.), other textiles (7·2 per cent.), metal and minerals other than coal and iron (12 per cent.). There was a season decline in the prices of house-coal. Since the end of July there has been some falling away partly due, no doubt, to a decline on American markets generally, where also the somewhat larger official estimate than was expected of the coming cotton crop has helped to disturb the prices both of "spot" cotton and futures. The price of English wheat, "Gazette Average," has advanced 28 per cent. during the three months, and of Northern Manitoba Wheat (No. 2) 22 per cent. Tin, though lower in price in July than in June, was still nearly 40 per cent. above April prices. Rubber increased by over 60 per cent. Prices of materials generally were in July, 1933, 11 per cent. above those ruling in July, 1932, but prices of articles of food were over 6 per cent. below those of a year ago.

The index-numbers are given below for the four months April to July, 1933, and for July 1932 :—

Average for 1930 = 100.

Month.					Total Food.	Total not Food.	All Articles.
April, 1933	...	...	...	...	79.6	82.3	81.3
May, "	...	...	...	...	80.6	84.5	83.1
June, "	...	...	...	...	81.8	87.0	85.1
July, "	...	...	...	...	80.1	88.8	85.6
July, 1932	...	...	...	...	85.3	80.0	81.8

The *Economist* fortnightly index-number of wholesale prices registers over a similar period a somewhat greater advance, being 59.6 at 19 April, 1933, and 65.3 at 26 July (1927 = 100), textiles and "miscellaneous articles" (including rubber) showing greater advances at the extreme points of the period.

The index-number of the *Statist*, for the end of July, 1933, shows an increase of 4.1 per cent. compared with the end of April, prices of materials advancing 7.2 per cent. and prices of food-stuffs declining about 0.7 per cent. owing principally to a fall in animal foods of about 4.5 per cent. The general index-numbers (1866-77 = 100) at the end of each of the four months April to July, 1933, were 78.5, 80.9, 81.3 and 81.7.

The trend of British prices as compared with those of certain foreign countries is shown below.

	Board of Trade (1930 - 100).	<i>Economist</i> (1927 = 100).*	<i>Statist</i> (1866-77 = 100).*	U.S.A. (Brad- street) (1913 = 100).*	France (<i>Stat. Gen.</i>) (1913 = 100).	Germany (<i>Reichsamt</i>) (1913 = 100).
April, 1933 ...	81.3	59.6	78.5	75.8	384	90.7
May, " ...	83.1	63.6	80.9	87.1	382	91.9
June, " ...	85.1	65.0	81.3	90.5	396	92.9
July, " ...	85.6	65.3	81.7	97.8	397	--
July, 1932 ...	81.8	60.1	78.9	73.8	404	95.9

* End of month.

According to the index-number of Stock Exchange Securities published in the *Banker's Magazine*, Fixed Interest Stocks declined about 2 per cent. over the three months mid-April to mid-July, 1933, while Variable Dividend Securities rose in value about 16 per cent. Part of this rise was no doubt due to the speculative activity in the United States during the latter part of the period, but the prices of industrial shares have generally advanced, while both the Ordinary and Preference Stocks of English Railways have shown noticeable

appreciation. The general index-numbers (December, 1921 = 100) at the middle of each of the last four months were, April 112·4, May 112·5, June 114·3, July 115·9.

There has been no permanent improvement in shipping freights during the present year, and though prices have improved somewhat during the last three months they are still below the level of January and February. They were, however, in July nearly 9 per cent. above the level of July, 1932. The index-number compiled by the Chamber of Shipping and published in the *Statist* gives the position as 18·17 in July, 1933 (1920 = 100), and as 17·43 and 18·10 respectively in May and June. In July, 1932, the index-number stood at 16·68, the lowest figure for any month during the last fourteen years.

The returns of the amount of retail sales, prepared each month by the Incorporated Association of Retail Distributors and the Bank of England, and published in the *Board of Trade Journal*, showed little change in April and May, 1933, as compared with the corresponding months a year ago, the decline in the value of sales of food being counterbalanced by increases in the value of the sales of other articles. In July, however, there was a fall in the values both of articles of food and of other articles of 3·3 per cent. and 3·9 per cent. respectively as compared with June, 1932. Over the five months February-June, 1933, there was a decline in sales of 2·0 per cent., which is considerably less than the amount of the decline in retail cost of living as shown by the Ministry of Labour's index-number over the same period.

The fall in the *retail prices* of articles of working-class consumption comprised in the index-number of the Ministry of Labour, which had been continuous since the beginning of October, 1932, was arrested at the beginning of June, 1933. At that date the index-number remained at 136 (level of July, 1914 = 100). At 1 October, 1932, it was 143. The number for food only had fallen from 125 to 114 over the same period. At 1 July, 1933, however, the index-number for articles of food rose $3\frac{1}{2}$ per cent., and a further rise of 0·8 per cent. at 1 August caused the general index-number to advance to 139, bringing it back to the level at 1 March, 1933. It is still considerably below any figure for recent years. It is noticeable that butter and margarine are now appreciably lower in price than at July, 1914. Apart from the inferior cuts of beef and mutton these are the only articles lower in price than before the war, although cheese and bacon are reported to be very little dearer.

The following table gives for the principal foreign countries and the Overseas Dominions the percentage increases in July, 1932, and,

on the latest available date, of the retail prices of food and other items compared with the prices at July, 1914.

	Retail Prices of Food at		Retail Prices of all Items at		Date of Latest Returns.
	July, 1932.	Latest date available.	July, 1932.	Latest date available.	
	%	%	%	%	1933
Great Britain	25	19	43	39	1 Aug.
<i>Overseas Dominions, etc.</i>					
Australia	23	17	20 *	16 †	June
Canada	- 8	- 5	25	20	July
Irish Free State	34 ‡	26	53 ‡	48	May
New Zealand	8	4	31 ‡	27	July
South Africa	- 6	- 1	17	15	June
<i>Foreign Countries.</i>					
Belgium	—	—	608	597	June
Czechoslovakia	9	5	2	2	May
Denmark	15	17	54	60	July
Egypt (Cairo)	8	1	28	26	May
Finland	756	752	894	867	June
Franco (Paris)	443	407	417 *	416 §	July
Germany	14	11	22	19	July
Holland (Amsterdam)	—	—	41 ||	37	June
Italy	318	298	—	259 ¶	June
Norway	34	30	49	47	June
Spain (Madrid)	79	84	—	—	March
Sweden	28	22	56	53	July
Switzerland	24	16	38	31	June
United States	1	- 3	36 ||	32 **	June
* 3rd Quarter, 1932. † 1st Quarter, 1933. ‡ Aug. 1932. § 2nd Quarter. || June, 1932. ¶ Jan.-June, 1933. ** Dec. 1932.					

Unemployment, which since the end of January, 1933, had shown a continuous decrease until the end of June, rose very slightly at the end of July, but this rise was due entirely to an increase in the number of those temporarily stopped, possibly owing to the near approach of the August holidays. The number of those wholly unemployed continued to fall and at the end of July was nearly 425,000 less than at the end of January, 1933, and about 140,000 less than at the end of July, 1932. The rate of unemployment in the insured trades, which was 22.9 per cent. at the end of January and 21.2 per cent. at the end of April, remained at 19.4 per cent. at the end of July—the same rate as for June. The improvement during the year has embraced most industries with the exception of mining and shipbuilding. The position in the cotton trade, however, is somewhat doubtful, though employment is considerably better than

a year ago. In the woollen and worsted trades the improvement has been marked. In nearly all the metal industries and in engineering employment, though slack and in some cases bad, is on a distinctly higher level than at the end of July, 1932. The figures showing the number of unemployed persons on the registers of the Employment Exchanges in Great Britain issued monthly by the Ministry of Labour are given below for April to July:—

Date.	Wholly Unemployed	Temporarily Stopped.	Persons normally in Casual Employment.	Total.
April 24, 1933 ...	2,070,814	527,418	99,402	2,697,634
May 22, „ ...	1,998,567	490,243	94,069	2,582,879
June 26, „ ...	1,884,322	463,712	90,074	2,438,108
July 24, „ ...	1,835,214	501,702	85,259	2,442,175
July 25, 1932 ...	1,995,453	721,552	94,777	2,811,782

According to statistics published in the *Reicharbeitsmarkt Anzeiger*, employment in Germany has continued to improve during the last three months and at the end of July, 1933, the number reported as unemployed had fallen from 5,331,252 at the end of April to 4,468,518, of whom 1,895,707 were in receipt of poor relief, 394,115 in receipt of standard unemployment benefit and 1,251,804 in receipt of emergency benefit. It is not quite clear, however, whether the numbers returned as unemployed cover the whole extent of unemployment. The figures relating to unemployment among members of trade unions have not been published for a later date than the end of May, when the rate of unemployment was given as 44·7 per cent. over a membership of about 2,600,000.

Employment shows slight improvement in France although the numbers on the registers of Employment Exchanges have dropped considerably during the last three months. The special monthly investigation covering industrial and commercial undertakings that employ at least 100 workers shows that at the beginning of July employment was still worse than a year ago to the extent of 1·3 per cent. Since this investigation was started at the beginning of 1931, in no single month has employment shown an improvement compared with the preceding year. The differences which were considerable in each month of 1931 and 1932 are now, however, comparatively small.

In Belgium the rate of unemployment among members of the subsidized unemployment funds has continued to decline since the beginning of the year, and of their million members about 16·4 per

cent. were out of work at the end of May, 1933. Employment on the whole is somewhat better than a year ago.

Employment in the Scandinavian countries, although showing a seasonal improvement, is not so good as a year ago and at the end of June, 1933, the rates of unemployment in trade unions in Denmark and Sweden were 22.4 per cent. and 20.7 per cent. respectively. In Norway at the end of May the rate was 25.5 per cent.

In Italy employment, which was worse than in 1932 for the first five months of the year, improved appreciably during June and the number of unemployed recorded in the *Statistics of National Fascist Institute of Social Welfare* at the end of that month (883,621) showed a fall of 116,000 compared with May, 1933, and of 21,000 compared with June, 1932.

Employment in the United States has improved steadily during the last four months and at an increased rate during June and July. According to returns received by the Federal Bureau of Labor Statistics from about 18,000 firms in the principal manufacturing industries, the increase in the number employed over the previous month was 1.6 per cent. for April, 4.8 per cent. for May, 7 per cent. for June and 7.2 per cent. for July. The increases in the earnings show somewhat larger percentages for the same four months, viz. 4.5, 11.5, 10.8 and 7.9 per cent. respectively. The monthly index-number of employment (average of 1926 = 100) was 67.3 for July, which is higher than in any month since October, 1931. The percentage unemployed among members of trade unions affiliated to the American Federation of Labor in 24 cities was 31 per cent. in June and July, 1933, compared with 34 per cent. from January to March and 33 per cent. in April and May, 1933.

In Canada there has been considerable improvement since the early spring and the index-number of employment (average of 1926 = 100) has risen from 76.0 at the beginning of April to 84.5 at the beginning of July. Employment, however, is still below the level of 1932.

The Bureau of Statistics of the Ministry of Industries of the National Government of China has recently issued a volume of *Industrial Statistics* (Vol. I, No. 1, February, 1933). The text is entirely in Chinese, except for a few translations of headings, sources of reference, names of American and English authors, etc., which are evidence of the care given to the preparation; but on the other hand, nearly half the book consists of tables of arabic numerals with headings in English, which present no difficulty of interpretation. These tables include Chinese cotton statistics (trade, cultiva-

tion, yield), production of coal, copper, petroleum, gold and silver, Chinese import and export figures, and price indices, as well as a number of comparative tables showing figures of various kinds for a number of countries.

The Econometric Society, founded in December 1930, for the "Advancement of Economic Theory in its Relation to Statistics and Mathematics," is now well established in membership and reputation. Its roll of members, which has developed rapidly, includes statisticians and economists of all nations who have applied mathematics to economic problems. Well-attended meetings of the European members were held in Lausanne in September, 1931, and in Paris in October, 1932; the papers read were of considerable interest and importance, and the discussions, formal and informal, were keen and apposite. A similar reunion is arranged at Leyden in the first days of October this year. Meetings also take place in the United States. Contact among the widely scattered members is maintained by the quarterly Journal of the Society, named *Econometrica*, of which the third number was issued in July, 1933. The Journal in itself would justify the existence of the Society, for it makes it evident that there is a margin of territory between those covered by the existing economic and statistical journals which needs cultivation and promises a valuable harvest. It is true that many econometric studies are already to be found in older periodicals and in specialist books; but, since work of this nature appeals only to a limited number, editors cannot find room for all that is available, unless they exclude studies of wider interest. Duplication of publication is to be avoided; but econometricians will be helped by the periodical surveys of current literature that are an important feature of the new Journal; it is arranged that surveys of Significant Developments in Statistical Information (Marschak), in General Economic Theory (Tinbergen), in Statistical Technique (Darmois) will appear during the coming twelve months.

The papers in the first three numbers of the Journal cover a wide range of subjects. There have already been Surveys of Business Cycle Theory (Hansen and Tout) and of Statistical Technique (Shewhart). On the business side of statistics we find The Rôle of Statistical Method in Economic Standardization (Shewhart), Accountants' Income Procedure (Canning) and Can Stock Market Forecasters Forecast? (Cowles). In statistical method we have Maverick on Time Series and Shohat on Interpolation. Mathematical economics is represented by papers by Ricci, Tinbergen, Schultz, Divisia, and others. Among other well-known contributors

are Darmois and Ezekiel. The history of Econometrics finds a place in a series of sympathetic studies of pioneers in the subject; so far, Cournot and Knut Wicksell.

The Council of the Econometric Society consists of Professor Irving Fisher (President), Professor Divisia (Vice-President), C. F. Roos (Secretary), Alfred Cowles, 3rd (Treasurer), Professor Frisch (Editor), Professors Amoroso, Bowley, Schumpeter, and E. B. Wilson, and Wl. Zawadzki, Vice-Minister of Finance, Poland.

To become a member of the Society (Annual Subscription \$3.00) a person must be proposed by two members and then be nominated by the Council. Professor Bowley states that he will be glad to facilitate the candidature of Fellows of the Royal Statistical Society.

The International Statistical Institute ceased the publication of its *Bulletin Mensuel* at the end of 1932. This periodical provided what was originally the only résumé, in comparative tables, of the principal statistical information published by the various countries of the world. Similar tables are, however, compiled by the League of Nations, and the Bureau of the Institute has judged it opportune to substitute a periodical which should provide a medium of contact for the members between the biennial meetings. The new organ, *La Revue de l'Institut International de Statistique*, is being issued quarterly. The aim of the editors, as expressed in an introductory note by the President, Dr. Zahn, is to contribute to the expansion and improvement of international statistics, and to keep members in different countries in touch with developments elsewhere. One portion of the review, under the editorship of Dr. Verriijn Stuart, is accordingly devoted to special articles dealing with some aspects or applications of statistical science, contributed by members of the Institute. Another part, which is edited by Dr. Methorst and the Central Bureau and begins with a section headed "Methodologie, législation, organisation et administration statistiques," consists of notes on new methods and results and on various matters of current interest to statisticians. A bibliographical section catalogues the latest statistical books and articles published in various countries, and is followed by lists of the central and municipal statistical organisations of the principal countries and of societies for the promotion of statistics. Finally, there are seventeen pages of tabular matter, of which fourteen give wholesale commodity prices in the principal world markets for each of the nine latest possible months, with the average for each of the nine preceding calendar years. These are in continuation of the tables formerly included in the *Bulletin Mensuel*. The

most recent figures are also issued in advance to members who desire to have them. The remaining tables show quarterly population movements and causes of death for a number of countries, with a table showing the formula for calculating the crude birth and death rates in each. It is intended that original articles in the scientific section shall appear in various languages, with summaries in French or English or both, and the first number (issued last April) illustrates the principle, with its three main papers in French, Italian, and English respectively, namely: *Parallélisme, Corrélation, Causalité*, by the late Lucien March, *La Statistica delle nascite secondo l'ordine di generazione*, by F. Savorgnan, and *Index-numbers of Wages, a Survey*, by J. W. Nixon. The first is a mathematical exposition and is especially designed to draw attention to the danger of assuming causality from correlation; the second examines the fertility statistics of various countries and presents a new system of classification; the third is a useful review of the information available on wage movements, including a conspectus of the principal indices and other periodical records of wage movements published in different parts of the world, tabulated in columns showing territorial scope, periodicity, base, industrial scope, rates or earnings, system of weighting, and categories of workers.

The second number was issued in July, and, besides containing papers by A. L. Bowley, J. Rahts, and T. Hasegawa, has a new section for reports and papers to be presented at the next meeting of the Institute. By this means, it will be possible to avoid part of the delay in publication of reports on special subjects, which hitherto has been caused by the long intervals between meetings and the time that elapses before the proceedings at them are published. It is believed that the efficiency of the Institute will be greatly improved by the new Review.

The Japanese mortality experience of 1912-1927* relates to "ordinary" assurances effected with nineteen offices—"industrial" assurance is in the hands of the Government. To give an idea of the extent of the business it may be mentioned that in 1930 there were 5,300,000 policies. Rather more than three-quarters of the assurances were "endowment assurances" and about four-fifths of the business was effected on male lives. The rates of mortality do not differ much from the old Japanese three-offices' experience and

* *Japanese Experience Life Tables, 1912-1927*. Tokyo Department of Commerce and Industry; with a volume of Monetary Tables, published by the Life Insurance Companies Association.

display the same characteristic of a decreasing mortality from age 20 to age 30.—The mortality is far heavier than that of the old British experience of assured lives for 1863–1893, so that the “expectations-of-life,” at the ages at which insurances are effected, are three or sometimes four years less than by that table.

The tables chosen for practical use analyse the mortality for the first three years of insurance—a sensible simplification—but, with only three years “selection,” it seems that a full aggregate table as well as a table excluding those three years is an unnecessary multiplication of tabular matter. The tables were graduated by grafting figures from a Spencer-21 term formula on to a Makeham graduation—the latter relates to the old-age part of the table.

The volume of monetary tables will be of interest to actuaries rather than to statisticians: it may be remarked that the extensive publication of continuous functions implies that in “ordinary” business in Japan premiums are paid at more frequent intervals than in this country.

There have recently come to hand four monographs published by Cornell University in 1932, which are of some particular interest. The earliest is a report by Howard J. Stover on the *Relation of Daily Prices to the Marketing of Hogs at Chicago*. That relation is of much more importance to the farmer than seasonal, cyclical, or secular changes, and Mr. Stover’s analysis produces such results as that supplies were greatest on Monday and Thursday, that prices were greatest on Monday and lowest on Wednesday and Saturday, that the adjustment of prices to receipts was greatest on Wednesday and least on Saturday, and that the adjustment of prices to receipts for the week as a whole was greater than for any one day. Another agricultural monograph, *Multiple Correlation Analysis as applied to Farm-Management Research*, by Stanley W. Warren, deals with the correlations between labour income and farm area, crop area, capital, productive man units, number of cows, crop index, dairy products, etc., and with sundry other correlations.

Messrs. G. F. Warren and F. A. Pearson in *The Physical Volume of Production in the United States*, give index-numbers of the “total basic production” (crops, forest products, electric current, water power, coal, other fuel, other minerals, secondary metals) from 1839 to 1932 and also index numbers of the output per head. Other tables give index numbers of the volume of building permits in selected cities from 1899 to 1932 (and also of the volume per

head), and of detailed forest and mineral products. The fourth pamphlet (of 222 pages), *Wholesale Prices for 213 years, 1720 to 1932*, is composed of two parts, "Wholesale Prices in the United States for 135 years, 1797 to 1932," by Messrs. Warren and Pearson, and "Wholesale Prices at New York City, 1720 to 1932," by Herman M. Stoker. The former is concerned with the construction of a monthly index-number for the whole period, with discussions on the effects of declining commodity prices and on money and prices; there is also a full account of the methods of construction of the index numbers. Mr. Stoker's paper is brief and on similar lines. These two pamphlets contain much of general interest and will, doubtless, form useful quarries for other students and investigators.

Members of the Study Group will remember that two years ago Dr. Horace Secrist, Director of the Bureau of Business Research of the North-western University (Illinois), read a paper in which he placed before them some of the results of enquiries which he had been conducting into retail business in the United States. After ten years of work in collecting, collating, and analyzing material from many fields, he has now published through his University a book under the provocative title, *The Triumph of Mediocrity in Business* (xxx + 468 pages). "Mediocrity," he says, is "a brief term for expressing average conditions," and its "triumph" is the expression of a tendency. Psychologists conclude that the repetition of a task improves its performance, but this rule he does not find to hold in business. To take one example, the examination of a series of department stores over a period of eleven years, "it is found that those on the average who were relatively skilled—had low expenses—rather than improving their condition, subsequently had higher expenses; and that those on the average who were relatively unskilled—had high expenses—subsequently had lower expenses. . . . In trade the problem to be solved is of such a character that the effort of one participant directly or indirectly affects that of others, the consequence being that exceptional skill, or its opposite, tends to be transitory and mediocrity to become the rule. . . . Both expenses and profits approach the mean or, to use Sir Francis Galton's expression, 'regress to type.'" These conclusions hold, according to Dr. Secrist, not only for departmental stores, but for retail clothing stores, retail hardware stores, wholesale grocery stores, banks, railroads, and crops; as a "control" over the method of obtaining "regressive patterns" a study of temperature rates is added. One cannot withhold a tribute of admiration for the author

and his assistants for the enthusiasm and pertinacity with which they have carried to the end an extremely laborious task.

Statisticians will in due course examine the methods employed, and economists will scrutinize the results in relation to accepted theory. Here we will quote one of Dr. Secrist's principal generalizations. "Complete freedom to enter trade and the continuance of competition mean the perpetuation of mediocrity. New firms are recruited from the relatively 'unfit'—at least from the inexperienced. If some succeed, they must meet the competitive practices of the class, the market, to which they belong. Superior judgment, merchandizing sense, and honesty, however, are always at the mercy of the unscrupulous, the unwise, the misinformed, and the injudicious. The results are that retail trade is overcrowded, shops are small and inefficient, volume of business inadequate, expenses relatively high, and profits small. So long as the field of activity is freely entered, and it is; and so long as competition is 'free,' and, within the limits suggested above, it is; neither superiority nor inferiority will tend to persist. Rather mediocrity tends to become the rule. The average level of the intelligence of those conducting business holds sway, and the practices common to such trade mentality becomes the rule." The business man may, however, take some comfort, for "the level of mediocrity may and does change." Moreover, regressive tendencies are strongest "where conditions are most subject to direct control, as for instance in the matter of wages and some other prime costs," but "when they are less readily determined, as, for instance, in the matter of net profits from operation, the levelling effects are less evident and probably more capable of being withstood." We thank Dr. Secrist for having placed before us a new assemblage of economic data.

Volume V of the *New Survey of London Life and Labour*, which is about to be published,* contains the second instalment of the Industrial Survey of present-day London. This branch of the New Survey is concerned with the Londoner as a worker. Its aim is to describe and analyse the conditions under which Londoners work, as the Social Survey (the other great branch of the Enquiry) endeavours to depict the conditions under which Londoners live.

Volume II included studies of the conditions prevailing in two of the largest London industrial groups, viz. building, engineering and kindred trades, besides a number of East London industries

* P. S. King and Son, Ltd. Price 17s. 6d.

(dock labour, clothing, bootmaking, and furniture) which in Charles Booth's time were specially associated with poverty and sweating. It also dealt with domestic service.

The present volume continues this series of studies, and covers industries in which about a million persons, or two-fifths of the entire occupied population of Greater London, are engaged. On the whole distributive trades (retail trading, wholesale markets, water transport) occupy a bigger place in this volume than in Volume II, but some very large and important productive industries are also included, *e.g.* the manufacture of food, drink and tobacco, the chemical and kindred trades, and the printing and bookbinding, leather and fur industries. The volume also deals with the important service of laundries, which has undergone a revolution since Charles Booth's day.

The general scheme adopted for each industry has been to show its comparative size and its growth or decline, and the changes of methods and organization which have taken place since the time of Charles Booth's Survey. Particular attention has been given to all matters which directly affect the life and labour of the people of London who are employed in the industry, *e.g.* mechanization, working conditions, trade organization, employment of women and juveniles, hours of labour, wages and earnings, unemployment, and recruitment and training.

Descriptions of manufacturing and other processes are given where an explanation of these technical matters is necessary to an understanding of the working conditions.

A review of the volume will appear in a later issue of the *Journal*.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS.

UNITED KINGDOM—

Accountants' Magazine, July, 1933—Cost accounting in the woollen trade : *J. R. Blyth*.

Bankers' Magazine, July, 1933—The progress of banking in Great Britain and Ireland during 1932. Investment with a view to income appreciation : *E. G. Peake*. International monetary policy—how currencies should be stabilized : *Douglas H. Peacock*.

Economic Journal, June, 1933—British overseas investments in 1931 : *Sir Robert Kindersley*. The national income in 1932 : *Colin Clark*. The economics of road and rail competition : *Gilbert Walker*. The last eighteen months in Japan : *Prof. Skene Smith*.

Lloyds Bank Monthly Review—

June, 1933—Sterling and the gold standard : *Frédéric Jenny*.

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April, 1933—Public works and credit policies: *H. L. Puzley*. A note on the elasticities of demand and supply: *Amiya Kumar Das-Gupta*. Indian gold exports: *H. Sinha*.

UNION OF SOUTH AFRICA—

South African Journal of Economics—

March, 1933—Robinson Crusoe economics: *H. M. Robertson*. Die Vraagstuk van Prysstabilisasie: *Prof. C. G. W. Schumann*. South African monetary policy: *Prof. S. Herbert Frankel* (with an addendum by *Prof. R. Leslie*).

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EGYPT—

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March, 1933—Le rôle du tourisme dans l'économie nationale : *Angelo Mariotti*. La crise présente de l'étalon-or : *C. Bresciani-Turroni*.

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Deutsches Statistisches Zentralblatt, April-May, 1933—Bemerkungen zum statistischen Hochschulunterricht: *Paul Flaskämper*.

Vierteljahrshefte zur Konjunkturforschung—

Heft 1, 1933—Die Konjunktur in Deutschland mitte Juni 1933.

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Journal de la Société Hongroise de Statistique, No. 4, 1932—Contribution à la statistique de la population éparsée: population des fermes, hameaux et autres territoires extérieurs, en Hongrie: *Louis Thirring*.

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Annali di Economia, No. 2, 1932—Ricerche sopra la teoria generale della moneta: *Gustavo del Vecchio* (whole number).

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May, 1933—La dinamica della popolazione secondo Francesco Ferrara: *Celestino Arena*. Sulla funzione monetaria dell'oro: *Vincenzo Porri*. Il nuovo catasto agrario: *Paolo Albertario*.

June, 1933—Appunti economici sulla riduzione delle ore di lavoro: *Libero Lenti*. La dinamica della popolazione secondo Francesco Ferrara: *Celestino Arena*.

Giornale di Matematica Finanziaria, March, 1933—Su note proprietà attribuite alle funzione quiquetiane e valide per ogni ultra funzione di sopravvivenza: *F. Insolera*. Zur Berechnung des Risikos der fernerer Dauer von kontinuierlich berechneten Versicherungen mit zwei verschiedenen Möglichkeiten des Ausscheidens: *Hans Koeppler*. Condizione di esistenza della rendita vitalizia a termini variabili in progressione aritmetica nel regime di capitalizzazione composta annua: *F. Giaccardi*.

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Ekonomisk Tidsskrift, Part 2, 1933—Till frågan om penningteoriens uppläggning : *Bertil Ohlin*.

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Part I, 1933—Parallélisme, corrélation, causalité (avec résumé anglais) : *L. March*. La statistica delle nascite secondo l'ordine di generazione (avec résumé anglais et français) : *F. Savorgnan*. Index-numbers of wages (avec résumé français) : *J. W. Nixon*.

Part II, 1933—Methods of investigating the economic and social conditions of a great city (avec résumé français) : *A. L. Bowley*. Ueber den Schluss der Sterbetafeln (avec résumé français) : *J. Rahts*. The population of greater Tokyo (avec résumé français) : *T. Hasegawa*.

ADDITIONS TO THE LIBRARY.

Since the issue of Part III, 1933, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS.

(a) United Kingdom and its several Divisions.

United Kingdom—

Colonial Office—

Report of a commission appointed to consider problems of secondary and primary education in Trinidad, Barbados, Leeward Islands and Windward Islands, 1931–32. 127 pp. 2s.

Visit to Malaya, 1932. Report of *Brigadier-General Sir Samuel Wilson*. 46 pp. 1s. [London: H.M.S.O., 1933. 9½" × 6".]

Commissioners of Crown Lands. The hundred and eleventh report of the Commissioners. . . . Dated 26th June 1933. London: H.M.S.O., 1933. 13" × 8½"; 40 pp. 2s. 6d.

Education, Board of. Adult education and the local education authority. (Paper No. 11 of the Adult Education Committee.) London: H.M.S.O., 1933. 7¼" × 4½"; x + 171 pp. 2s. 6d.

General Register Office—

Census of England and Wales, 1931. Counties of Anglesey and Caernarvon (Part I). xxii + 38 pp. 3s. Counties of Cardigan and Pembrokeshire (Part I). xxii + 41 pp. 3s. County of Cornwall (Part I). xxi + 45 pp. 3s. Counties of Denbigh and Flint (Part I). xxii + 40 pp. 3s. County of Devon (Part I). xxi + 57 pp. 3s. 6d. County of Dorset (Part I). xix + 31 pp. 2s. 6d. Counties of Lincoln and Rutland (Part I). xxii + 75 pp. 4s. 6d. Counties of Merioneth, Montgomery and Radnor (Part I). xxiv + 45 pp. 3s. 6d. County of Norfolk (Part I). xix + 50 pp. 3s. 6d. County of Oxford (Part II). 17 pp. 1s. County of Somerset (Part I). xix + 49 pp. 3s. County of Suffolk (Part I). xxi + 47 pp. 3s. County of Wilts. (Part I). xviii + 35 pp. 2s. 6d. [London: H.M.S.O., 1933. 13" × 8".]

Imperial Institute. The mineral industry of the British Empire and foreign countries. Lead. 2nd ed. London: H.M.S.O., 1933. 9½" × 6"; 253 pp. 4s.

Medical Research Council. Special report series 180. Epidemiological study of scarlet fever in England and Wales since 1900. By *Hilda M. Woods*. London: H.M.S.O., 1933. 9½" × 6"; 61 pp. 1s. 3d.

Overseas Trade, Department of—

Reports: 546. Belgium in 1932. 140 pp. 4s. 547. Australia, Dec. 1932. 160 pp. 4s. 6d. 458. Czechoslovakia, Mar. 1933. 60 pp. 2s. 550. Netherlands East Indies, Feb. 1933. 164 pp. 4s. 6d. 551. Argentine Republic, Jan. 1933. 193 pp. 5s. 552. Newfoundland, April 1933. [London: H.M.S.O., 1933. 9½" × 6".]

Northern Ireland—

Commerce, Ministry of. Census of production of Northern Ireland 1930. Report. Belfast: H.M.S.O., 1932. 9½" × 6"; 265 pp. 2s. 6d.

Scotland—

Agriculture, Department of. Report on the marketing of live-stock in Scotland. Edinburgh: H.M.S.O., 1933. 9½" × 6"; 129 pp. 1s.

(b) Dominions, Colonies, and Protectorates.

Irish Free State—

Industry and Commerce, Department of. Census of population 1926. Vol. IX. Dependency. Dublin: Stationery Office, 1933. 10" × 6½"; vi + 59 pp. 1s.

Straits Settlements—

Annual report of the Education Department for the year 1931. By F. J. Morten. Singapore, 1932. 13" × 8½"; 65 pp. (From Mr. Curwen.)

Zanzibar—

Statistics of the Zanzibar Protectorate 1893–1932. By R. H. Crofton. Zanzibar, 1933. 10" × 6½"; 28 pp.

(c) Foreign Countries.

Austria—

Bundesamt für Statistik. Gewerbliche Betriebszahlung in der Republik Österreich vom 14 Juni 1930. Systematisches und alphabetisches Verzeichnis der Gewerbearten und Gewerbebenennungen. Wien, 1933. 14" × 10½"; 62 pp. 6 Sch.

Brazil—

Departamento Nacional de Estatística—

Comercio exterior do Brasil. Annos 1920–1930. Rio de Janeiro, 1933. 11½" × 8½"; xxxvii + 554 pp.

Divisão administrativa do Brasil. Índice alfabético dos municípios e distritos existentes em 1º de Janeiro de 1933. Rio de Janeiro, 1933. 10½" × 7"; v + 194 pp.

Limites dos Estados Unidos do Brasil. Sistematização provisória das linhas de limite do território da República e do de cada uma das suas unidades políticas. Rio de Janeiro, 1933. 10½" × 7"; xiii + 77 pp.

Chile—

Dirección General de Estadística. Censo de la población efectuado el 27 de noviembre de 1930. Vol. II. Santiago, 1933. 10½" × 7½"; xi + 512 pp.

China—

Industries, Ministry of. Bureau of Statistics—

The industrial statistics. Vol. 1. No. 1. February 1933. Nanking, 1933. 10½" × 7½".

Price indexes in China and foreign countries, 1932. Nanking, N.D. 9½" × 6½"; 247 pp.

Czechoslovakia—

L'Office de Statistique—

Arbres et arbustes fruitiers dans la République Tchécoslovaque d'après l'état au 20 septembre 1930. xx + 127 pp. 25 Kč.

Fortune des personnes physiques, relevée dans la Province de Bohême lors de l'établissement de la taxe sur la fortune en 1919. 175 pp. 25 Kč.

Manuel statistique de la République Tchécoslovaque IV. xvi + 487 pp. 45 Kč.

Mouvement de la population dans la République Tchécoslovaque dans les années 1925–27. xxxvii + 28 + 721 pp. 100 Kč.

[Prague, 1932. 12" × 9½".]

Denmark—

København. Staden Københavns Statistiske Kontor, 1883–1933. Af Kjeld Johansen. København, 1933. 8½" × 6"; 126 pp.

(c) Foreign Countries—Contd.

Dutch East Indies—

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France—*Statistique Générale de la France—*

Résultats statistiques du recensement général de la population effectué le 8 mars 1931. Tome I, première partie. Paris, 1933. 16½" × 8½"; 142 pp.

Statistique de forces motrices en 1926. Paris, 1931. 10½" × 8½"; 238 pp.

Germany—*Statistisches Reichsamt—*

Internationaler Steuerbelastungsvergleich. Die Steuer- und Soziallasten der gewerblichen und kaufmannischen Betrieb in Deutschland, Frankreich, Grossbritannien, Italien, Österreich und den Vereinigten Staaten von Amerika. Berlin: R. Hobbing, 1933. 11½" × 8½"; xxi + 779 pp. 20 Rm.

Statistik des deutschen Reichs. Band 436. Die Seeschifffahrt im Jahre 1932. Heft 1. Guterverkehr über See in den deutschen Häfen. 74 pp. 5 Rm. Band 437. Die Ausgaben und Einnahmen der öffentlichen Verwaltung im deutschen Reich für die Rechnungsjahre 1929–30 und 1930–31. 159 pp. 9 Rm. Berlin, 1933. 12" × 8½".

Italy—*Istituto Centrale di Statistica.* Annali di statistica. Serie VI—

Vol. XIV. Statistica dell'istruzione superiore nell'anno accademico 1926–27. xi + 367 pp. L. 20.

Vol. XXIX. Atti del Consiglio Superiore di Statistica. Sessione ordinaria 14–15 dicembre 1932. Verbali delle sedute e relazione illustrative dell'attività dell'Istituto . . . dal novembre 1931 al novembre 1932. 496 pp. L. 25. [Rome, 1933. 10½" × 7½".]

Luxemburg—

L'Office de Statistique. Bulletin trimestriel. Année I, No. 1, Mai 1933. Luxembourg, 1933. 11½" × 9". 20 pp.

Palestine—

Education, Department of. Annual report 1930–1931. Jerusalem, 1932. 13" × 8½"; 55 pp. + xxx + tables. 100 mils. (From Mr. Curwen.)

Peru—

Censo de las Provincias de Lima y Callao. Levantado el 13 de noviembre de 1931. Lima, 1933. 9½" × 7"; 318 pp.

Poland—

L'Office Central de Statistique. Série B. Fasc. 13. Logements, données provisoires sur la base du deuxième recensement général de la population du 9. xii. 1931. Warsaw, 1933. 10½" × 8"; 40 pp.

Spain—*Dirección General del Instituto Geográfico, Catastral y de Estadística—*

Boletín del Centro de Investigaciones Especiales o Laboratorio de Estadística. Número extraordinario, 1 junio 1933. 80 pp. 5 charts. Número 2. 1 julio, 1933. 24 pp. Madrid: Hijos de M. G. Hernandez, 1933. 10½" × 7½".

Censo de la población de España . . . el 31 de diciembre de 1930. Tomo I. Madrid, 1932. 10½" × 8½"; lxxxviii + 482 pp.

Sweden—

K. Socialstyrelsen. Arbetstidsförhållandena inom detaljhandeln. Stockholm, 1933. 9½" × 6½"; 160 pp.

(c) Foreign Countries—Contd.

Switzerland—

Bureau Fédéral de Statistique—

Eidgenössische Volkszählung 1 Dez. 1930. Band 3. Kanton Aargau. 119 pp. Band 4. Kanton Zürich. 219 pp. Bern, 1933.

Les exploitations d'industries et de métiers en Suisse. Commentaires analytiques. 4me vol., illustré. Des résultats du recensement des entreprises en 1929. 199 + 29 pp. [Bern, 1933. 11½" × 8¼".]

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Circulars : 251. Mushroom growing in the United States. 34 pp. 5 c.

— 252. Commercial cabbage culture. 59 pp. 5 c.

— 258. Farmers' opinions and other factors influencing cotton production and acreage adjustments in the south. 41 pp. 5 c.

— 261. The farm real estate situation, 1931–32. 50 pp. 5 c.

Farmers' bulletin, 1395. Beef-cattle production in the range area.

Miscellaneous publication, 156. The agricultural outlook for 1933. 99 pp. N.P. [Washington, 1932–33. 9" × 6".]

Census, Bureau of the—

Census of manufactures, 1929. Statistics for industries and states. 11¼" × 9"; 21 pp. 5 c.

Census of manufactures, 1931. Summary by states. 8" × 10¼"; 9 pp.

Summary by industries. 15" × 8"; 15 pp. [Washington, 1932.]

Children's Bureau—

Publications : 216. The A.B.C. of foster-family care for children. 50 pp. 5 c.

— 218. Employed boys and girls in Rochester and Utica, New York. 74 pp. 10 c.

— 219. Good posture in the little child. 25 pp. 5 c.

[Washington, 1933. 9" × 6".]

Labor Statistics, Bureau of—

Bulletins : 577. International Association of Industrial Accident Boards and Commissions. vi + 242 pp. 20 c.

— 579. Wages and hours of labor in the boot and shoe industry, 1910 to 1932. 111 + vii pp. 10 c. [Washington, 1933. 9" × 6".]

Women's Bureau. Bulletin, 104. The occupational progress of women, 1910 to 1930. Washington, 1933. 9" × 6"; v + 90 pp. 10 c.

(d) International.

League of Nations—

Monetary and Economic Conference (London, 1933). An account of the preparatory work for the conference and an outline of the previous activities of the economic and financial organization of the League.

Geneva (London : Allen and Unwin), 1933. 9" × 6¼"; 94 pp. 1s.

Review of world trade, 1932. Geneva, 1933. 10¼" × 8"; 64 pp.

International Institute of Agriculture—

The agricultural situation in 1931–32. . . . Economic commentary on the International Yearbook of Agricultural Statistics for 1931–32. viii + 536 pp. L. 25.

Memorandum on the agricultural aspects of the problems before the Conference (with 7 appendices). 8 parts. [Rome, 1933. 9¼" × 6¼".]

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By J. H. Richardson. Geneva (London : P. S. King), 1933. 9¼" × 6"; xi + 272 pp. 5s.

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- Allen (G. C.). British industries and their organization. London: Longmans, 1933. $8\frac{1}{2}" \times 5\frac{1}{2}"$; xi + 338 pp. 10s. 6d.
- Antonucci (A.). La liquidation financière de la guerre et la reconstruction en Europe centrale. Paris: Giard, 1933. $9" \times 5\frac{1}{2}"$; 463 pp. 50 fr.
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- Bachi (Riccardo). Le regioni nell'economia nazionale. Rome: Reprint from *Atti dell'Istituto Nazionale delle Assicurazioni*, Vol. V, 1933. $10" \times 7\frac{1}{4}"$; 55 pp. L. 6.
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- Boag (Harold). Capital and income. Paper given to the North-East Coast Association of Chartered Secretaries, 16th Feb. 1933. $9\frac{1}{2}" \times 6\frac{1}{4}"$; pp. 377–398. (From the author.)
- Broomhall (G. J. S.). Broomhall's Corn Trade Yearbook; a reference book for grain merchants and millers. International grain trade statistics. Liverpool: Northern Publishing Co., 1933. $8\frac{1}{2}" \times 5\frac{1}{4}"$; xxiv + 150 pp. (From the author.)
- California, University of. Publications in economics—
Vol. 11. No. 1. Thorstein Veblen. A chapter in American economic thought. By Richard Victor Teggart. 1932. Pp. viii + 1–126.
Vol. 11. No. 2. Railroad consolidation west of the Mississippi river. By Stuart Daggett. 1933. Pp. 127–356.
Vol. 12. Nos. 1–2. Mexican labor in the United States migration statistics, II and III. By Paul S. Taylor. 1933. Pp. 1–10, and 11–22.
[California: University Press. $10\frac{1}{2}" \times 6\frac{1}{2}"$.]
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- Dalla Volta (Riccardo). Scritti vari di economia e finanza. Firenze: Libr. Int. Seeber, 1931. $10" \times 7"$; 625 pp. L. 40. (From the author.)
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- Admiralty.* Health of the Navy. Fleets. Navy, Appropriation account, Navy, Dockyard expense accounts.
- Agriculture and Fisheries, Ministry of.* Agricultural market report. Journal of the Ministry of Agriculture. Agricultural statistics. Diseases of animals. Sea Fisheries: Report; Statistical tables.
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- Charity Commission.* Report.
- Civil Service Commission.* Report.
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- Control, Board of.* Lunacy, vol. 1.
- Crown Lands, Office of Commissioners of.* Report.
- Customs and Excise, Commissioners of.* Report.
- Development Commission.* Report.
- Ecclesiastical Commission.* Report.
- Education, Board of.* Annual report. Health of the school child.
- Electricity Commission.* Annual report. Engineering and Financial statistics. Generation of electricity.
- Empire Marketing Board.* Annual report.
- Friendly Societies, Registry of.* Reports of the Chief Registrar. Industrial Assurance Commissioner, Report.
- General Register Office.* Weekly return of births and deaths. Quarterly return of births, deaths and marriages. Registrar-General's Statistical review.
- Health, Ministry of.* Annual report. Alkali works, report. Local taxation returns. Poor relief, quarterly statement. Local rates and rateable value.
- Government Actuary's Department.* Guide to Current Official Statistics.
- Home Office.* Aliens Restriction Acts, statistics. Criminal statistics. Report of Chief Inspector of Factories and Workshops. Licensing statistics. Police (Counties and Boroughs), report of H.M. Inspector. Police, Report of the Commissioner for Metropolis. Street accidents, return. Race-course Betting Control Board report. Workmen's compensation statistics.
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Mineral production.

Monthly review of business statistics.

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Manual of Statistics.

Jamaica—

Vital Statistics.

Malaya—

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Mauritius—

Blue Book.

New Zealand—*Census and Statistics Office.*

Agricultural and pastoral production.

External migration.

Factory production.

Friendly Societies and Trades Unions.

Insurance.

Justice.

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Jaarcijfers voor Nederland.

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Norges Offisielle Statistik (including annual reports on—Agriculture and Live-stock, Assurance, Crime, Finance, Fisheries, Industrial Production, Mineral industry, Milk industry, Postal and Telegraph services, Public Health, Railways, Trade, Veterinary Service, etc.).

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Conjuncture Institute, Economic Bulletin.

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Sociala meddelanden.

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Statistisk årsbok.

STOCKHOLM.

Statistiska Kontor.

Statistisk årsbok.

Switzerland—

Bureau Fédéral de Statistique.

Annuaire statistique.

Annual returns relating to: Agricultural Statistics, Assurance Societies, Crime, Finance, Forestry, Live-stock, Vital Statistics.

Direction Générale des Douanes Fédérales.

Statistique du Commerce de la Suisse avec l'étranger [annual and monthly returns].

Rapport annuel.

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Quarterly Journal of Economics.

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Anuario estadistico (in parts).

Sintesis estadistica.

MONTEVIDEO. Shipping Statistics.

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Int. Year-book of Agricultural Statistics. Int. Year-book of Agricultural Legislation. Agricultural Situation. International Review of Agriculture, and other publications.

International Labour Office—

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Aperçu de la Démographie.

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